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The Fan Motor Season.

Reports from various parts of the country show that the hot weather of last week, unprecedented for the early part of June, gave a sudden and tremendous impetus to the sale of fan motors. Many of the supply houses were soon exhausted. The manufacturers, although busily engaged getting ready, were not able to deliver all at once the quantities demanded, and we hear of one concern with a popular brand which to oblige one pressing customer gave an advance of $2 per fan in order to get back quickly some that it had already delivered elsewhere. All the predictions as to a busy fan motor season are being realized, and there is some possibility that a shortage of fans may be experienced. When business is dull, fewer people are employed in summer and many of those work short hours. When business is brisk, as now, the number of persons at work, in all classes of employment, is materially increased and one of the results is that expense is not spared in making the conditions endurable. Last week, during the hot days, the number of fan motors being carried around was so large as to excite general comment.

At the same time, we believe the number could be greatly increased by a definite campaign. We have inquired of several business concerns, and find that no one has been near them suggesting or offering fan motors. The demand appears to be that of initiative chiefly on the part of the purchaser. So far as we can ascertain, little effort is made to sell fans by instalment or to take care of them for a small sum and clean them up when the season is over. The fact that a fan can earn more in a few summer months than a lamp does all through the winter ought to appeal to central station managers.

Electrolytic Lamp Filaments.

In another column we print a description abstracted from a patent issued last week to Mr. T. A. Edison, on an electrolytic lamp filament. As will be noted, Mr. Edison offers a solution to the very important problem in this type of lamp—the preliminary heating of the filament to a point when the refractory material becomes conducting. This he accomplishes by incorporating carbonaceous matter in the pores of the refractory material. According to the patent, when the filament is subjected to a proper potential, a semi-conduction is produced by arcs established between the carbon particles, thus heating the refractory material to the necessary degree for the normal operation of the lamp. An important feature of the patent is provision for a surface having a high radiating capacity, a lack of which is characteristic of the refractory material employed.

As we go to press the English patent record brings to hand an abstract of a patent issued to Ritter von Welsbach, on a filament very similar to that described in the Edison patent. The date of the latter is June 6, 1899, the application having been filed March 31, 1898, while the Welsbach patent was accepted May 19, 1899, and the application filed June 11, 1898. The processes of manufacture of the two filaments are very closely allied. In both patents a refractory oxide is mixed with a carbonaceous glutinant, then kneaded until of uniform consistence, then formed into a filament. The threads thus produced are dried and subsequently carbonized. The Welsbach patent does not provide for a special radiating surface, and metallic osmium is added to the refractory oxides. The operation of the Edison patent is based upon the presence of carbonaceous particles in the body of the material, while the specification of the Welsbach patent states that in the process of carbonization, the carbon compound is burned up, the refractory oxides being left behind. In both cases the filaments may be enclosed in air-exhausted globes.

THE DAY OF AUTOMOBILES.

If one thing stood out more prominently than another at the recent very successful electrical exhibition in Madison Square Garden, it was the deep impression caused by the electric automobiles shown there. Nor was the impression that of mere gaping wonder. It was largely a wealthy crowd that frequented the Garden, and the automobile exhibitors could have sold out their vehicles over and over again. It was also a varied crowd, for one concern alone, which sold some thirty carriages and wagons during the show, has to deliver the vehicles at about as many different points in this country and abroad. The orders and inquiries received by all the exhibitors leave barely a single part of this country untouched.

This is a striking manifestation of interest in the new departure, but the question remains to be settled: Who is to do the charging? And it is here that the alert central station manager should find his new opportunity. It is not likely that all the business will come his way, but a large proportion will be his if he cares to develop a day load or to operate to advantage in the idle hours of midnight. The possibilities are these: There are said to be in New York City, for example, 5000 ply-for-hire vehicles. If each of these took 50 cents' worth of current daily, as electrics, the consumption of current would reach not far short of $1,000,000 per annum, and it may be questioned whether another kilowatt of generating capacity would have to be installed to help furnish the current. Each manager can figure on the "proposition" for his own locality.

But this is not all. One hears a good deal to-day of the severe limitations of electricity as compared with gasolene and naphtha. Something might also be said, per contra, about the severe limitations of gasolene and naphtha. There will be plenty of room for all classes of automobiles, but for ourselves we beg to be excused from the odor and jolting of vehicles propelled by gas, steam or oil. Electricity is, we must confess, good enough for us, and we believe that the facilities for charging electric vehicles will soon be abundant not only within the cities but for many miles outside them, along every decent road. A time is rapidly coming when every enterprising road house and country wayside hotel will have its little charging plant ready to start up and do its work while the driver gets his glass of beer and a sandwich. The same plant will do the lighting at night, and thus through the automobile electricity will have received the stimulus in rural districts for which it has long been waiting. This plan does not anticipate greatly the probable march of events in the next few years.

ALUMINUM IN THE ELECTRICAL ART.

Some time ago we pointed out the advantages of aluminum for certain switchboard work, and in a recent issue of our London contemporary, *The Electrical Review*, Mr. Ernest Kilborn Scott takes up in considerable detail the subject of the application of aluminum in electrical work, and enumerates a number of the purposes for which it is particularly suited. In the case of heavy currents and long breaks, large switch levers are necessitated, which, if made of copper alloy, bring considerable stress on the slate or marble on which they are mounted, and consequently aluminum may be substituted with advantage. The connections between storage battery switches and the regulating cells are always, he states, a very heavy item, and these might with advantage be of aluminum. Aluminum brush holders on account of their light weight reduce the variation of pressure due to gravity, between the brushes on the top side and those on the under side of the commutator, and at the same time the total weight on the brush holder is considerably reduced, which is an advantage in machines of large size. Some of the portable testing sets, such as ammeters, ohmmeters, etc., are exceedingly heavy and makers are advised to use the lighter metal more freely.

Among the advantages enumerated to be derived from the use of aluminum wire for transmission lines are that in the case of plants in inaccessible localities, the considerable saving in weight in transportation would be an item, and incidentally there would also be a saving in insulators. For field telephone and telegraphic lines aluminum wire is recommended, and, as the size of the conductors for such work is fixed at a certain minimum, the saving in weight over copper would therefore be practically as 3.3 is to 1. It may be added that the advantages of aluminum for switchboard work in particular are so incontestable, that in the near future we may expect copper to be almost entirely replaced by it for that application. Indeed, that aluminum is not used more generally at present for this and other electrical purposes gives rise to a suspicion that there is a lack of enterprise on the part of those controlling the aluminum industry. A start has, however, been made with respect to line conductors, the example set at Snoqualmie having been followed by the Chicago Northwestern Elevated Railway, which has contracted for 75 tons of aluminum wire for feeders.

THE PASSING OF THE HORSE.

One of the most remarkable sociological indications of the present time is that the horse is doomed to disappear slowly among civilized communities. We say slowly, because his departure is so gradual that a single year scarcely makes the change perceptible to the eye, and many years must pass before he will cease to be a prominent object in city streets. But, however, slow the process of disappearance may be, it seems inevitable, and points to influences in civilization that are ever active and powerful, to that slow revolution which is spelled without the initial "r."

For hundreds of years the horse has been a potent factor in civilization. It was the man on horseback who could travel great distances and overcome great obstacles. Horses pulled the plow of peace and bore the warrior in war. Skill in horsemanship was for centuries the mark of the noblest and greatest, and a relic of this stage of civilization is found in the word "gentleman," which in several European languages literally means "horseman."

During the last hundred years special study has been given to mechanism for producing and delivering power ,and machines have been gradually developed which demonstrate the superiority of art over nature in apparatus of this class. A locomotive and tender weighing 150 times as much as a horse can develop 1000-hp with much greater speed than horses can attain and with but very slight fatigue, so that the locomotive engine has displaced the coach-horse for all long-distance transportation. The electric motor for street car service weighs about 100 pounds per average horse-power developed, while the horse weighs about 1000 pounds per horse-power developed. The street car horse cannot be worked economically more than 15 miles a day. The street car motor is readily worked 100 miles a day, while the speeds and loads of the street-car motor are much greater than horses could secure. Consequently, the street-car motor has almost entirely displaced the street-car horse.

Machinery not content with excluding the horse from the rails, has now commenced to turn the horse off the street. The mechanical horse is lighter, more compact, faster, more enduring, cleaner, more perfectly under control, and, under some conditions, cheaper. As soon as the conditions have been so modified that the cheapness will be generally extended instead of specially limited, the horse will go. But with more than 15 millions of horses in the United States in 1896, the change will evidently be a matter of decades.

THE DYNAMICAL THEORY OF THE ZEEMAN EFFECT.

It is well known that when a flame is subjected to a powerful magnetic field and the spectrum of the flame is examined with great care and magnification, the lines of the spectrum are found to split into separate dual components, so that each line becomes divided into a pair of close parallel lines. The effect was discovered by Zeeman and is usually called by his name. It has been shown that if the atoms of an incandescent gas consist of electrified particles or ions, that is to say, of minute particles carrying fixed and invariable electric charges, such as we are led to suppose may be the case from the phenomena of electrolysis; then if these ions spin or describe minute orbits around an axis of rotation, each such rotating member is the equivalent of a circular electric current or a current passing perpetually in the orbit loop. A powerful magnetic field brought to bear upon such circular currents may necessarily exert an electromagnetic force upon them, tending to distort the orbits. These distortions would be similar to the distortions in the path of a circular revolving pendulum by the insertion of a gyrostat into the bob of the pendulum. The nature of this distortion is such that the period of rotation is virtually altered and split into two nearly equal components, one slightly above, and the other slightly below the normal speed of rotation. This is in apparent agreement with the spectrum observations of the Zeeman effect ,since one of the two line components represents a slightly retarded vibration and the other slightly accelerated vibration.

The conclusion is therefore suggested that orbital movement of electrical charges does take place within a molecule of any substance. If this is true, two entirely different phenomena can be accounted for in a general way. One is that these rotated electrified ions being the equivalents of circular currents are really atomic magnets, and it is possible that the structural relation of the atoms in the molecule may or may not enable this magnetic condition to be externally developed. That is to say, the molecule of iron might be of such structure that the magnetism is externally developed, while the molecule of copper might be such that the magnetism would be neutralized within the molecule. Moreover, this rotation of charges constitutes energy although it does not imply the waste of energy. It might, however, account for the store of chemical energy in a molecule which is liberated under certain chemical unions. In other words, it is possible that the union of two molecules might result in the mutual arrest of the atomic orbits with the liberation of the previously stored energy in the form of oscillation of the molecules bodily; i. e., as heat. It is hardly necessary to add, however, that such hypotheses are merely speculations until further evidence has been accumulated.

FOUR-WIRE THREE-PHASE DISTRIBUTION SYSTEMS.

For the distribution of alternating currents to lamps and motors by means of a secondary network there are available several alternative arrangements of the several circuits and the different number of wires per circuit. Where the motors are of small size and consequently capable of running on single-phase current, single-phase distribution on the three-wire system seems to be preferred, different sections of the network being run on the different circuits of the station if, as is coming to be common practice, polyphase machines are installed even for feeding single-phase loads. A three-wire single-phase distributing network may have added to it a fourth wire, forming one leg of another circuit for motor purposes. One of the outside wires of the first or lighting circuit may serve as a return for the second circuit, and therefore be common to the two. Such a system is used in Hartford. On the other hand, the return of the second circuit may be the neutral of the three-wire or lighting circuit. Such an arrangement becomes either a monocyclic, a two-phase or a three-phase "Scott connection" system, according to the winding of the motors.

By far the simplest and undoubtedly the most satisfactory distributing arrangement is the so-called four-wire three-phase star or branch connection, which consists simply of three single-phase two-wire circuits differing from each other by 120 degrees in phase, and with one leg of each in common forming a fourth or neutral wire, in which under balanced loads no current flows, just as no current flows under the same conditions in Edison three-wire systems. Strange as it may seem at first sight, the economy of copper on such a system, although there is no multi-wire arrangement of each individual phase, is even greater than that of the Edison three-wire system with the same difference of potential between the neutral and outer conductors. With this arrangement utilizing, let us say, 117 volts between the neutral and any one of the three outers, the three-phase or delta voltage between any two of the three outers will be 200 volts and the economy of copper in the outers will be the same as that of a direct-current 234-volt system. If, as is usual in Edison circuits, the neutral main is made of the same cross section as any one of the outer conductors, it will be considerably smaller than the neutral of a three-wire single-phase or direct-current system carrying the same load at the same voltage. Such systems are in quite extended use in Europe and are coming into service in this country—an article by Mr. A. J. Bowie on another page describing tests made on a plant of this kind —and their operation contradicts the argument sometimes put forward, based upon the assumed necessity of low tension local distribution mains for the three-phase system in combination with the Edison three-wire system, thus making six circuits, in order that the lamps may divide in such a manner that the balance will be maintained quite nearly at all times, at each or adjacent customers. It has been customary to arrange the wires of overhead polyphase transmission lines in such a way that a cross section of the line would show them at the corners of an imaginary polygon representing vectorially the electromotive forces delivered to them. Thus three-phase lines were put up on two cross arms with the three insulators at the corners of an equilateral triangle, and two-phase lines were put up with the four insulators at the corners of a square or diamond shaped parallelogram. In the latter case this arrangement eliminated any mutual induction between one circuit and the other, but in the former case—that of the three-phase circuit—it simply rendered the inductive influence of the line in the ether surrounding it a rotary field, the advantage of which is hard to see.

Of late years it has become customary to put the three or four wires of a three or two-phase system upon one cross arm, sometimes with and sometimes without, transpositions or spiraling. As might be expected, this gives in the case of the two-phase system a mutual induction tending to throw the two phases out of an exact quarter period relation with each other unless the two wires of one phase are transposed over half the distance, the two wires of the other circuit running through without transposition. In case three-phase circuits are run on one cross arm without transposition, the self-inductance of the conductor between the two conductors most distant from each other upon the cross arm, is naturally greater than that between either one of these outside wires and the third wire between them, which might be expected to cause an unbalancing of the vectorial relations of the electromotive forces as well as of their relative magnitudes. This effect might be expected to be most evident on low-tension systems distributing currents of considerable magnitude, and disastrous effects of this kind were found on such a system, as recounted by Mr. Bowie in the article referred to above. It should be noted that pure spiraling—that is, the carrying of the right hand wire over to the left hand side and the left hand wire under to the right hand side—does not in any way cure this difficulty, the only cure being an actual transposition of each wire to the central pins on the cross arm for one-third of the line length.

Independent Telephone Association of the U. S. A.

The Advisory Board of the Independent Telephone Association of the United States met with the telephone manufacturers and supply men on June 7 at the Auditorium Annex, Chicago, to discuss the policy of the annual meeting of the Association with other matters of interest. Committees were appointed and the meeting adjourned to meet at 11 o'clock a. m., June 8, at which meeting it was determined to hold the annual convention of said Association June 26, 27 and 28 at the Auditorium Hotel.

The Executive Committee and Advisory Board will meet at 8 o'clock p. m. on the 26th in the parlor of the Auditorium Annex to settle all business matters of the year just closing and to formulate reports of officers and committees. The first session of the convention will be held in the banquet hall of the Auditorium Hotel at 10 o'clock a. m., June 27, and will be opened with the annual address of the president, Judge James M. Thomas, which will be followed by the reports of the officers and committees. This will be followed by introductions and a short social session at which new members will be received. After lunch at 2 o'clock p. m. another session will be held, the programme of which is as follows:

Paper by S. P. Sheerin, of Indianapolis, president of the New Long Distance Telephone Company, of Indiana. Subject: Value of Long Distance toll lines. Discussion. Paper by C. L. Boyce, manager of the Citizens' Telephone Company, of Grand Rapids, Mich. Subject: Operation and Maintenance. Discussion. Paper by Maxine Reber, electrical engineer, of Cuyahoga Telephone Company, of Cleveland, Ohio. Subject: Essentials of telephone construction. Discussion. Paper by Hon. Harry D. Critchfield, counsel for the United States Telephone Company, of Ohio. Subject: Development of the Independent Telephone business. Discussion.

At 3 o'clock p. m. on Wednesday the manufacturers and supply men will give an excursion on the lake followed by a ride through the city and parks on tallyhos. This will be an interesting feature of the occasion and will be a source of great pleasure.

At 8 o'clock p. m. all delegates and those in attendance will be seated in the banquet hall of the Auditorium Hotel, where a banquet will be enjoyed. This will close the convention. All persons connected in any way with the independent telephone interests are invited to attend the convention and participate in the pleasures offered by the excursion and banquet. Application for banquet tickets must be in the hands of the Advisory Board not later than Tuesday, the 27th, at 1 p. m.

Annual Report of the Electric Storage Battery Company.

The annual report of the Electric Storage Battery Company shows an active condition of business in that field. Figures given by President Isaac L. Rice show the following results:

Sales for the period from January 1, 1898, to Jan. 1, 1899 ..... $1,340,987.64
As against, for the period from Jan. 1, 1897, to Jan. 1, 1898 ..... 1,026,925.65

For the first five months of 1899 the sales amounted to $1,360,560.70, as against $314,498.33, for the same period in 1898.

Reckoning by the 12 months from June 1 ,1898, to June 1, 1899, the figures show sales of $2,387,049.91.

The total horse power capacity sold from the beginning of the company's business until May 31, 1898, amounted to 65,000-hp hours; and to May 31, 1899, they amounted to 149,000-hp hours, being an increase of 129.23 per cent. over all preceding periods combined.

For the first time in the history of the company an annual statement showing the treasury resources of the company is given. It is as follows:—$10,218,374.38. The company is entirely free from all bonded and floating indebtedness.

Mr. Rice also gives an account of the operations of the company in connection with the automobile business. By reason of these operations the company owns to-day five-twelfths of the automobile business as controlled by the Electric Vehicle Company and the Columbia Automobile Company, the Storage Battery Company owning about $4,000,000.00 of the stock of the former company, or one-third of the total issue, and has a half interest in the Columbia Automobile Company.

The two vehicle companies have united their patents and organized a manufacturing company called the "Columbia and Electric Vehicle Company, which manufactures the entire product with the exception of the storage batteries, which will be furnished solely by the Columbia Automobile Company. The entire product of this manufacturing company will be purchased by the Electric Vehicle Company and sold by it to the various electric vehicle transportation companies now organized and being organized throughout the country.

Formation of an Automobile Club.

Acting upon the initiative of Dr. Whitney Lyon, a number of gentlemen in New York City have taken steps to organize an Automobile Club which shall act as a representative and authoritative body. A meeting was held at the Waldorf-Astoria last week, when a committee of five were appointed to draft a constitution and by-laws and to report at the next meeting. These were Messrs. Charles R. Flint, W. Lyon, Gen. G. M. Smith, Dr. F. C. Hollister and W. H. Hall. A temporary treasurer was elected in Mr. W. E. Buzby and a temporary secretary in Capt. H. W. Hedge, of 120 Broadway. The name proposed is the Automobile Club of America and one idea is to put it in touch with the kindred organizations in France and England.

U. S. Circuit Court of Appeals Upholds Carty Bridging Bell Patent.

The United States Circuit Court of Appeals, for the Third Circuit, has sustained the decision of the lower court upholding the Carty bridging bell patent for telephones, in the suit of the Western Electric Company against the Milheim Electric Telephone Company et al. The Circuit judges are Acheson and Dallas, and the District judge is Kirkpatrick. The patent in question is No. 449,106, granted March 31, 1891, to John J. Carty, and, as is well known, relates broadly to bridging bell methods for enabling better telephonic transmission of speech on a party line by placing the apparatus in parallel as contrasted with the previous method of series arrangement for call generator, call bell, magnets, etc.

The decision says in regard to the Carty invention: "The bell magnet bridge was equipped with a magnet having a high co-efficient of self-induction and was normally and permanently closed at all stations. The generator bridge circuit was normally open but adapted to be closed when sending a call. The connection of the telephone in a third bridge circuit at each station was normally open but capable of being closed in multiple with its own bell magnet circuit and the bell magnet circuits of all the other stations when in use."

Describing the result of this method of operation which enabled the high frequency voice currents to travel unimpeded over their own low impedance circuit, the court says: "By this combination of devices Carty obtained the effect of two distinct and separate circuits, one of which was adapted to the low frequency currents of the bell generator and the other to the high frequency voice currents of the telephone. It also had the effect of electrically balancing the lines and thereby reducing to a minimum the annoyances of induction which had so seriously interfered with the usefulness of the old system.

"So far as the record shows, there was no anticipation of this device. All the elements of the combination had been used before and the functions of each were well known in the art, but it does not appear that they had ever been similarly specifically combined for effectuating the purpose here accomplished. The grant of the patent carries with it the presumption of patentability and this presumption has been strengthened by the general acceptance of the device the acquiescence of those skilled in the art and their willingness to accept licenses thereunder.

"We have carefully considered the questions of prior publication and anticipation. The differences between the patent in suit and those cited as most nearly approaching the Carty device have been fully and particularly set out in the opinion of the learned judge below. We fully concur in his conclusions and refrain from drawing the distinctions, lest we should but repeat what he has so clearly expressed.

"Infringement is charged in the bill and not denied except in the unverified answer. Complainant's witness after examination of defendant's system, testified that it was constructed and organized completely in accordance with the instructions contained in the patent in suit. Though these facts were peculiarly within their own knowledge the defendants offered no contradictory evidence bearing on the question. We are of opinion that the patent is valid and infringed. The decree of the Circuit Court will be affirmed."

Development of the Montmorency Falls.

BY E. M. ARCHIBALD.

OF the many falls in the Province of Quebec, Canada, perhaps the grandest as well as the most picturesque are those on the Montmorency. Indeed, in many people's estimation they outrival even mighty Niagara. This is due to the fact that the water is dissembled just at the very brink and falls in one mass of white, foaming spray no less than 267 feet to the rock bottom beneath, its mad career being there checked in the peaceful bosom of the mighty St. Lawrence.

Inasmuch as these falls are only seven miles distant from the city of Quebec, one would necessarily expect to find that they had at some early date been used for industrial purposes. Such is the case, for many years ago the river was dammed up some distance from the falls and power was supplied to run a large sawmill, the lumber trade then being and still remaining one of the chief industries of Quebec.

This had its day, and gave place to the Quebec & Levis Electric Light Company, which built a dam close to the falls, and by means of a wooden flume, supplied water to its power house situated under the bluff, near the river side. This company ran a number of arc machines, and, gradually expanding, introduced a single-phase alternating current system with machines producing current at a nominal pressure of 1000 volts. As, however, the city voltage required to be as high as 1000, and as their line drop has been found to have been about 50 per cent., No. 6 wire being used, the pressure at the machines must have been in the vicinity of 2000 volts.

The Montmorency Electric Power Company, Ltd., then came into existence, absorbed the old company and started a radical change, which has developed more and more, until to-day there have been evolved a power plant and a system of electrical distribution extremely creditable to those who have been the guiding spirits.

Meantime a cotton mill had been established at the foot of the falls and water power was furnished to run all its machinery. This must needs also expand, until now there are two large buildings requiring 1000-hp, which is furnished them in a manner as unique as it is satisfactory. This is nothing more nor less than by using the remaining potential energy of the discharge water from the present power house, which is situated some little distance above the mills.

To return, in the gradual change that has come about, an immense concrete dam has been built about 100 feet from the very brink of the falls. By referring, Fig. 1, the dam with the water rushing over its crest may be seen extending from bank to bank, a distance of 265 feet, its width varying with the river bottom, 23 feet being the maximum. The crest and apron are 5 and 22 feet in width, respectively. The construction was greatly facilitated by the presence of a huge granite boulder in midstream.

At the lett hand side of the dam is the gate house, a small wooden building, from the upper corner of which is a wing dam extending up stream 325 feet, enclosing on its shore side the head race, a body of calm, clear water. This wing dam is built of cribwork varying from 8 feet wide at the top to 20 feet at the bottom, the timbers in its construction being from 9 to 14 inches square, small granite rock filling up the spaces. Along the river bottom of this wing dam are seven apertures varying from 12 to 20 feet in width, all being about 7 feet high. By this means all floating rubbish is prevented from entering the head race. This dam was also built to get rid of frazil ice, that bugbear to Canadian water-power development. Frazil, that is, fine, needle-like crystals of ice, forms only in rapidly flowing water, where it has no opportunity of adhering and forming surface ice. During very cold weather, some of the rapidly flowing streams become full of it, even to the consistency of thick pea soup, and should this touch any sufficiently cold body it will immediately adhere and in a very short time form a small sized iceberg extending almost to the very bottom of the stream. The manner in which this wing dam carries off the frazil is as follows: The swift current of the

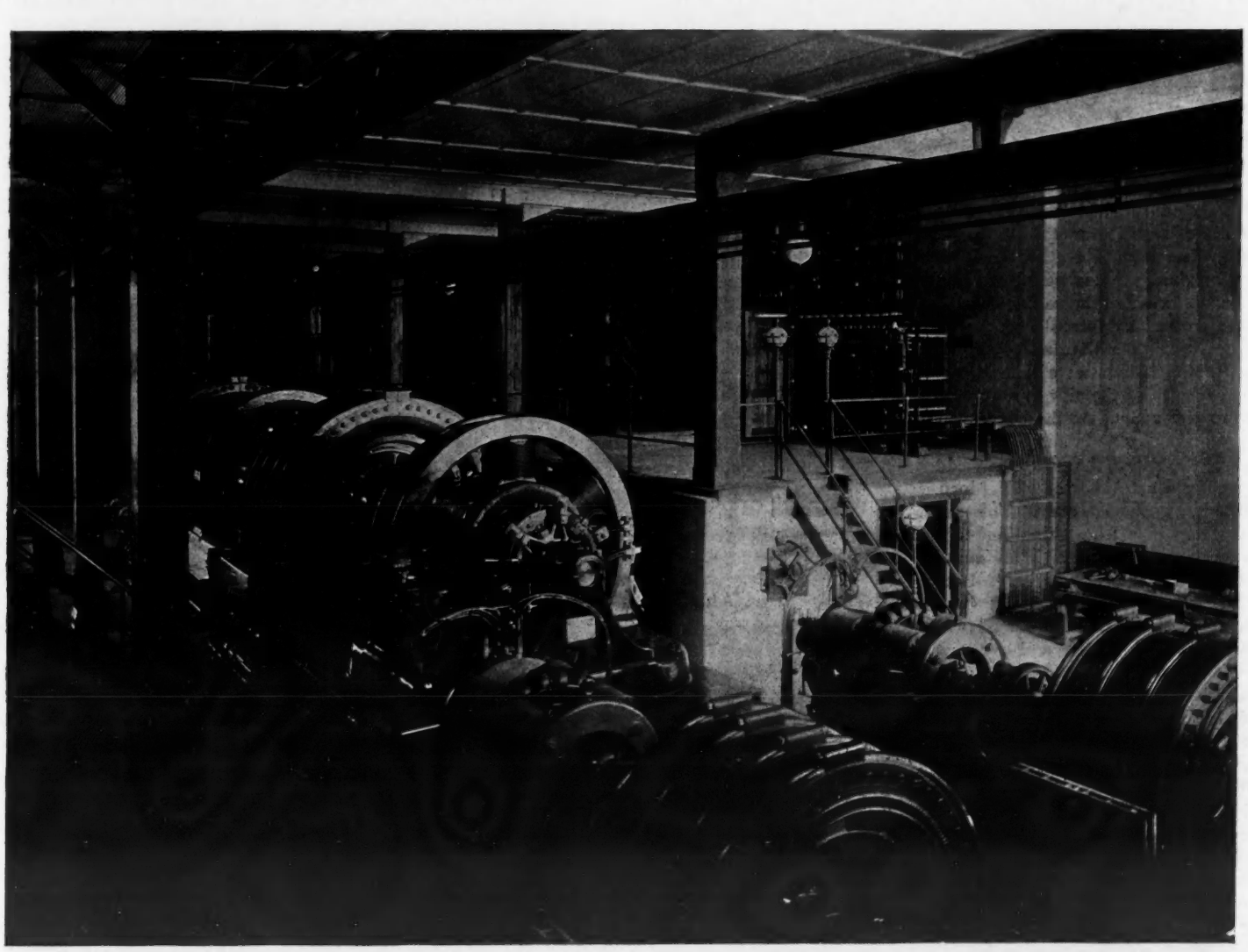


FIG. 1.—INTERIOR OF SUBSTATION.

river sweeps all the frazil down stream over the dam, none passing through the apertures in the cribwork on account of there being not sufficient current there to cause it to enter. Although this current is very slow, it is not still, because there must be the same amount of water enter the headrace as flows out through the pipe. This plan has been so successful that it has not been necessary to close down for an instant on account of frazil.

The entrance to the intake is in the gate house, and is protected by a heavy iron bar rack, which keeps it free from all rubbish. The intake pipe is of iron, 9 feet in diameter, reducing down to 8 feet,

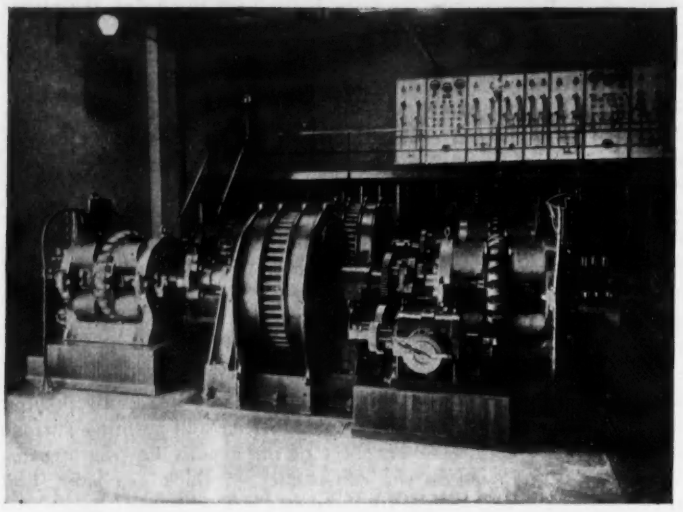


FIG. 2.—SYNCHRONOUS MOTOR AND ARC MACHINES.

which is the size of the upper end of the pipe line. The heavy gate to open or stop the flow of water in the pipe is operated in the gate house by means of a rack and reducing gear. There is another gate by which a sluice in the dam may be opened if it is required at any time to lower the level of the water in the dam.

PIPE LINE.

The upper end of the pipe line, 1509 feet in length and 8 feet in diameter, follows a sinuous path around the brow of the hill almost on a perfect level. After traversing this distance a 6-foot pipe is connected into it, which delivers all the water to the power house, a distance of 1150 feet away. At the junction of the two pipes a standpipe 47 feet high and 4 feet in diameter is erected. This was not there originally, but it was found that the pipe pulsated up and down 11 inches owing to the variation in the quantity of water used in the power house. By introducing this standpipe, in which the variation of pressure is equilibrated by the rise and fall of the water in the pipe, the pulsations were reduced to practically nothing.

The weight of the pipe line is carried by masonry piers 2 feet thick and 10 feet apart. At the curve where the pipe goes directly down to the power house is an anchorage consisting of a massive piece of masonry in which the pipe is embedded one-third of its depth, while encircling it are bands of ½ x 3-inch iron with anchor bolts securely embedded in the masonry. This anchorage takes the weight of the heavy iron pipe from this point to the power house. Between this anchorage and the power house another standpipe 147 feet high and 6 feet in diameter has been erected on a masonry bed 10 feet wide by 25 feet long by 10 feet deep. Though the top of this standpipe is 25 feet above the falls, occasionally when the valve on a wheel is suddenly closed, the water will overflow. Numerous steel guys hold it securely in position. Both standpipes have a double row of 1-inch boards around them covered on the inner and outer sides with two and three ply roofing paper, respectively, with a 3-inch air space, to prevent the water from freezing in winter. A stove is sometimes also used in extremely cold weather. The pipe line has a similar covering and also a pitched roof to free it from water.

No extra precaution is taken to allow for expansion and contraction of the pipe other than keeping the water running at all times, thus maintaining a practically uniform temperature. Any small effects are taken up by the numerous bends in the pipe.

A pipe 2 feet 6 inches in diameter lies adjacent to the pipe line during its down-hill course, acting as a drain pipe to discharge all the water which would otherwise flow around the pipe line.

POWER HOUSE.

The power house, situated on the side of the hill, is a plain limestone building 150 feet long by 50 feet wide. The framework is of wood with a structural iron roof. The floor is of hardwood on large wooden beams. The equipment consists of four 52-inch wheels, built by the Stilwell-Bierce & Smith-Vaile Co., of Dayton, Ohio, delivering 1000-hp each when running at 286 r. p. m. under a head of 195 feet. Each wheel has a Giesler electro-mechanical governor, operated by means of centrifugal balls making electrical contacts, the currents from which energize one or two friction clutches, belt-driven from the main shaft, and by means of bevel gearing opening or closing the cylindrical gate.

Each wheel is directly connected by means of an insulating semi-flexible leather coupling to a 600-kw two-phase S-K-C alternator delivering current at a frequency of 66 cycles per second direct to the line at a pressure of about 5500 volts, which voltage is reduced by line drop to 5000 at the substation. It might be interesting to note that three of these machines were the first of that style to be manufactured by the Stanley Manufacturing Company at Pittsfield, and they have not cost one cent for repairs during their four years operation. The other machine was built by the Royal Electric Company of Montreal, from the same design, but has only been in operation a short time.

There are two 75-volt, 30-kw bipolar exciters, each direct connected by insulating leather couplings to a 11-inch turbine rated at 50-hp running at 1200 r.p.m. A high-speed "Little Giant" wheel, built by J. C. Wilson & Co., of Picton, Ontario, is belt-connected to a 12-light T-H arc machine. This machine is of interest on account of its being the very first T-H arc machine to be built in Canada by the Royal Electric Co., of Montreal. Notwithstanding its age, 18 years, the original armature is still in good condition, never having been rewound, and the machine is operated about ten hours a day to light the power house.

There are five branches from the pipe line entering the power house, of which four only are in use at present. Each intake pipe is 3 feet in diameter while the draught tube, which extends obliquely downwards into a discharge tank, is 4 feet in diameter. This draught tube by suction adds an additional head of 17 feet to the original head of 178 feet, making a working head of 195 feet. The actual head is 208 feet, but 11 feet is destroyed in frictional loss. The discharge tank is 9 feet 9 inches wide by 7 feet deep by 140 feet in length, extending almost the entire length of the building. A pipe connects this discharge tank to the cotton mills below, through a measuring gate by which means the correct quantity of water contracted for is delivered. The contract calls for sufficient water to obtain 1000-hp in the mills. To ensure there being sufficient water in the discharge tank, a by-pass valve is placed at one end which allows

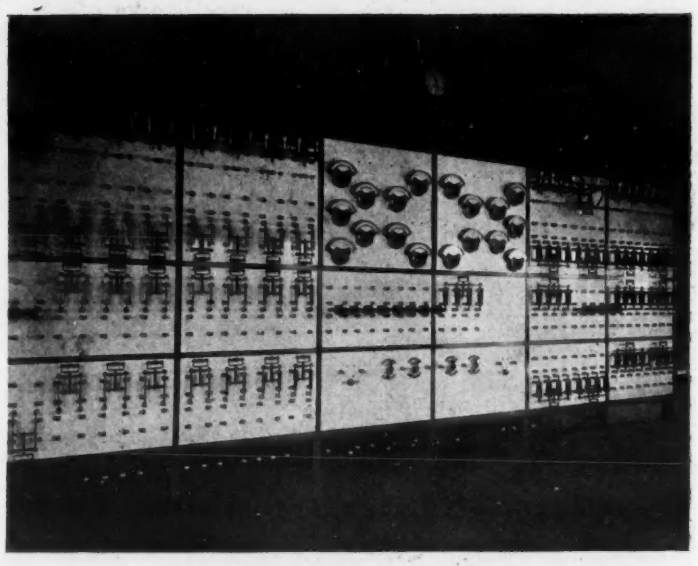


FIG. 3.—LIGHT AND POWER SWITCHBOARD IN SUBSTATION.

water to flow directly into the discharge tank should the level fall below a certain point.

The switchboard is composed of three white marble panels with polished hardwood frame. Each panel is divided into three subpanels. On this switchboard are situated all the instruments and rheostats for regulating the machines. Here is a voltmeter indicating the voltage at the substation, pressure wires being run all the way back to the power house for this purpose. The primary voltage of the machines is regulated to obtain the correct reading on this

voltmeter. A Chapman voltage regulator, made by the Belknap Motor Company, Portland, Me., has been tried on one of the machines, and has proved so satisfactory that they will be shortly installed on all the machines, taking the place of hand regulation. This regulator operates by means of a solenoid moving up and down completing one of two circuits through a pair of coils in which another solenoid moves to and fro making contact with more or less resistance coils placed as a shunt on the generator field.

The high-tension terminals pass directly from their respective machines to a transfer board, consisting of a number of sockets and connecting plugs by means of which any machine may be thrown on any line, for there are as many lines as machines. Thence they pass directly to these lines through two cupolas in the roof, taps being first taken off each wire to a lightning arrester, the majority of which are of the Wurt's non-arcing type, the remainder being the Stanley. Choke coils are used only with the Stanley arrester. Off any circuit a local line is run for supplying current to a neighboring village. For this circuit one 10-kw Stanley transformer is used, converting from 5000 to 2000 volts. On account of the primary voltage varying, it was necessary to introduce a regulator in the transformer to vary the rate of transformation by cutting in or out some of the coils. By means of this regulation the voltage can be varied as much as 10 per cent., thus maintaining a perfectly uniform light on this local circuit.

POLE LINE.

There are two pole lines, seven miles in length, for the 16 wires necessary for the four 4-wire two-phase machines, on account of their not being connected in multiple at the power house. This was found to be the only satisfactory method of obtaining a perfectly uniform light in the city, as it was then independent of the greatly varying street railway load. The wires pass through a slate panel in each cupola, by means of porcelain tubing, to the two pole lines. They are No. 0 medium drawn bare copper wires, 18 inches apart, four on each cross arm.

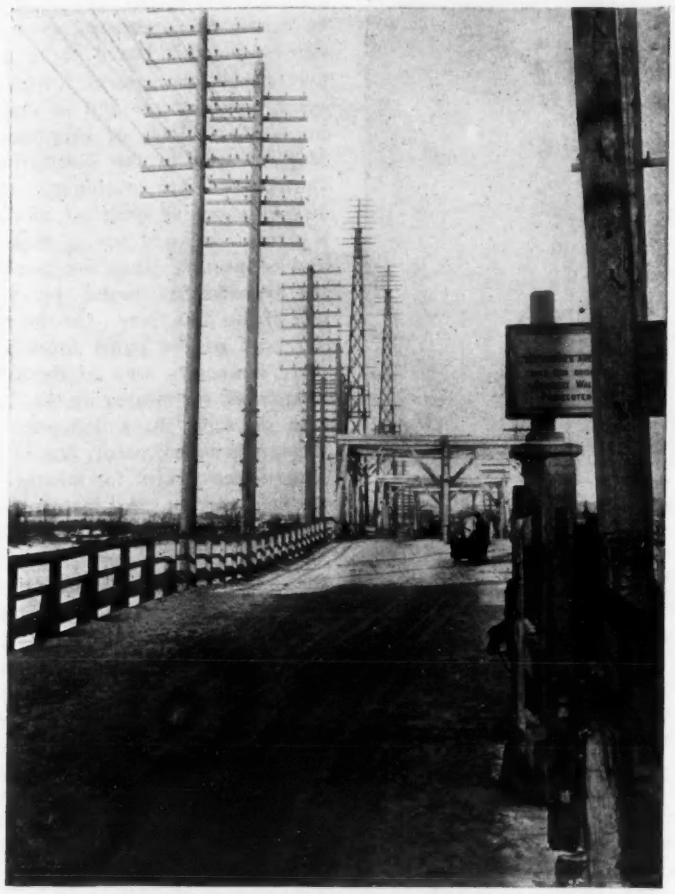


FIG. 4.—POLE LINE, SHOWING METHOD OF CROSSING RIVER BY TOWERS 140 FEET HIGH.

The two lines of eight wires each run parallel for some distance, about 100 feet apart, then branch off, and after following widely divergent lines finally converge and unite into one pole line at the bridge crossing the St. Charles River. As this river is navigable above the bridge, provision had to be made for either tunneling under the river or crossing the bridge at such a height as to clear the masts of any passing ships. The latter was decided on, and for this purpose two iron towers were built, 140 feet high, across which the wires are strung, the span being 50 feet. On account of the high winds, the distance between wires was increased to 21 inches.

The poles vary from 50 to 55 feet in height and are spaced 90 feet apart. Two barbed wires on the outside edges of the upper cross arms, grounded at every fifth pole, together with banks of lightning arresters at each end of the line, protect against lightning. Formerly double petticoat glass insulators were used, but owing to many of them breaking off at the cap, at which time their color turned from a bottle green to a pinkish red, they are being replaced by double petticoat porcelain insulators. The line voltage is 5000 and the drop is somewhat less than 10 per cent.

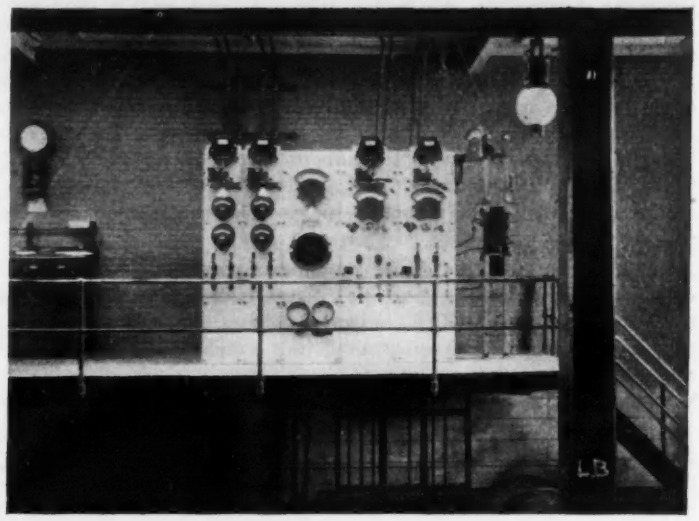


FIG. 5.—STREET RAILWAY SWITCHBOARD.

SUB-STATION.

Situated on Prince Edward Street, in Quebec, Lower Town, near the River St. Charles, a tributary of the St. Lawrence, is the substation, a handsome two-story native limestone structure. It contains the general offices of the company, storerooms, testing room, draughting room and the station equipment.

This equipment consists of 14 100-kw single-phase Stanley transformers, 10 of them being immersed in mineral oil in a cylindrical iron case and cooled by water circulation through pipes inside the case, the remaining four being also placed in cylindrical iron cases, but only air cooled. The water for these transformers is obtained from an artesian well sunk in the cellar 26 feet deep, from which water is pumped by means of a single-acting pump driven by a 2-hp belt-connected two-phase motor.

The transformers reduce the line voltage from 5000 to 2000 volts, and may be connected in banks of three in multiple or each separately on each phase by means of the transformer switchboard. The transformers are situated in a locked room on the ground floor by themselves.

On the same floor are two motor-generators, two synchronous motors direct-connected to four 125-light Brush multi-circuit arc machines, and two exciters direct-connected to two induction motors.

These motor-generators are two separate machines on separate bases, but direct-connected by means of an insulating leather coupling. The alternating side of each is a 600-kw two-phase S. K. C. synchronous motor taking current at a frequency of 66 direct from the line at a pressure of 5000 volts and running at 286 r. p. m. The direct current side is a General Electric 6-pole 450-kw generator delivering current to the Quebec District Railway at a pressure of 550 volts. To start this machine and bring it up to the speed of synchronism, a 30-hp 1000-volt two-phase S. K. C. induction motor is used which gears with a spur wheel on the synchronous motor shaft. When in synchronism this gearing is disengaged by means of an eccentric which throws the whole motor and gear wheel away from the synchronous motor. As the motor has not sufficient torque to start the huge inductor, weighing 14 tons, and the armature of the direct current generator, weighing 10 tons, other means are resorted to for a start, after which the torque of the motor is sufficient to rapidly speed up the massive moving parts. A ratchet is connected on the end of the induction motor shaft, on which a long lever with

a pawl attachment can easily be coupled. The torque produced by one man on this lever, together with the motor, is sufficient to start the machines. The machines are bolted to two tiers of 8 x 8 inch white pine timbers, which are in turn bolted to the stone foundations. These timbers were previously well soaked in boiling paraffin for purposes of insulation from ground.

For arc lighting there are four 125-light Brush multi-circuit arc machines. Ammeter, headboard and regulator are placed on the machines themselves. These are driven by two 200-kw two-phase S. K. C. synchronous motors at a speed of 500 r. p. m., the motors taking current direct from the line at a pressure of 5000 volts. Each motor is placed between two arc machines and direct-connected to them by means of two insulating leather couplings, one on each side as can be seen in the accompanying photograph. Each machine is brought up to synchronism by means of a 15-hp two-phase 1000-volt S. K. C. induction motor geared to the shaft of the synchronous motor, after which the induction motor is disengaged in a similar manner to that previously described.

For exciting the fields of the synchronous motors two 30-kw 75-volt multipolar Bullock machines direct connected to two 30-kw two-phase 1000-volt S. K. C. induction motors are used. Either one of these exciters is sufficient for all four synchronous motors, and also for another 600-kw unit to be installed. This makes a duplicate exciting plant. There are six Stanley transformers situated under one of the switchboard galleries, reducing the line voltage to 1000 for the four starting and the two exciter motors. Fuses are not used on any high tension lines.

In this substation there are no less than five separate switchboards. The line enters the building in the tower through a slate panel by means of porcelain tubes, and passes down to a small switchboard, taps being first taken off every line to lightning arresters of the Wurt non-arcing type, having 15 gaps between each wire and ground. Here it is put in multiple with two rows of switches, the upper ones, four double-pole four-point break high tension S. K. C. switches of the slide type connecting it to the transformer board; the lower ones are merely plugs not intended to break the circuit, but to simply connect the line to another high tension switchboard for placing any line on the synchronous motors.

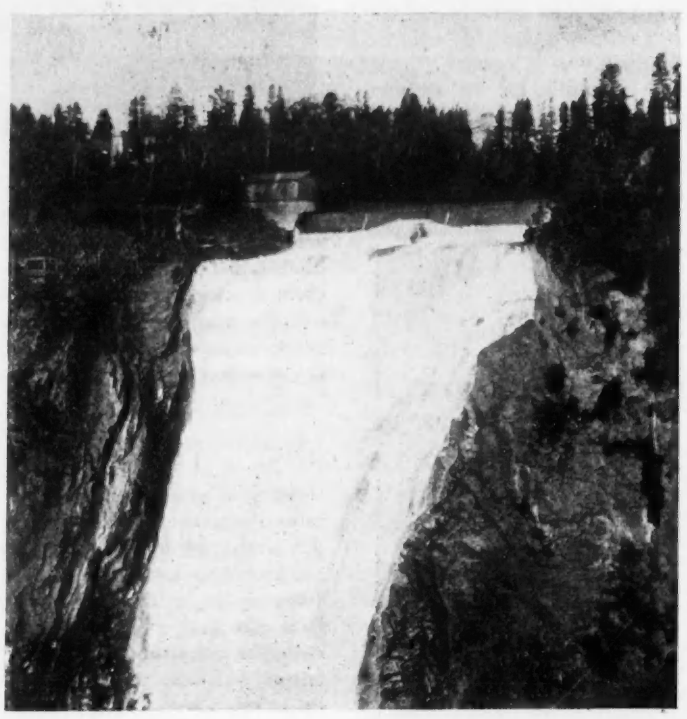


FIG. 6.—MONTMORENCY FALLS, SHOWING DAM AND GATE HOUSE.

On each panel of the transformer switchboard, which is constructed of six panels of white marble with a polished hardwood frame, there are two transfer boards, one in order to connect any primary circuit to any transformer to any set of bus-bars. This transfer board is of the socket and connecting plug type previously described. Besides the transfer boards there are also two switches on each panel, the upper being a double-pole four-point break 2000-volt switch, the lower a four-pole eight-point break with two contacts on each side in multiple, for breaking the 5000-volt primary connections to the transformers. These switches are all of the slide type, made by the Royal Electric Company, Montreal, for the S. K. C. system.

From the transformer board the secondaries run to a main switchboard on a gallery over the transformer room, a view of which is given in Fig. 2. This switchboard was originally designed to do the work that the transformer board now does, together with what itself is doing at the present, so that now there seems to be a multiplicity of switches on it. It consists of six white marble panels on a polished hardwood frame, each panel being again divided into three sub-panels. The two panels on the left are for incandescent lighting only, the two on the right for power only, while the two middle ones are machine and indicating panels. There are four 4-pole double-throw switches on the middle panels (only three of which are shown in the illustration) to connect any machine on either the lighting or power bus-bars. Above these are situated all the ammeters and voltmeters for indicating the load and voltage. These are all of the Whitney type. At the bottom of the board are the synchronizing apparatus and the static ground detectors. The connections for these phasing lamps are taken from the transformer secondaries, so that it is the transformers that are synchronized. But when the transformers are in phase, the machines supplying the current must also be in phase. All parallel coupling of machines is done at the substation and not at the power house.

On the two lighting panels are three rows of 8 double-pole double-throw switches, one for each city feeder, by means of which any circuit may be thrown on any bus-bars. At the top of the board are 8 Stanley double-pole circuit-breakers, one on each distributing circuit.

The distributing circuits have been so well designed as regards balancing of load, that there has been no need of any special device for that purpose.

The power side of the switchboard is a repetition of the lighting side except that all the switches and circuit breakers are four-pole instead of double-pole.

On a gallery on the opposite side of the substation are situated two switchboards, one for controlling the four synchronous motors and their starting motors, and the other the street railway board. The former is a long board of 20 white marble panels with polished hardwood frame. It was considered safer and better to have a perfectly non-conducting frame even with a slight danger from fire, than an iron frame, which, although fire proof, was liable to be raised to a potential of 5000 volts. On this board there are five panels necessary for each synchronous motor and its starting motor. Part of this board may be seen in the illustration, showing the arc machines. The second panel of each set of five is a transfer board having sockets and connecting plugs for placing the synchronous motor on any one of the four lines. On the upper part of the panel there are three ammeters, two of them 60 range each for measuring the current on each phase delivered to the synchronous motor, one of 90 range direct-current for measuring the field current. All instruments are of the round pattern and made by the Royal Electric Company, of Montreal. On the lower sub-panel is the field rheostat. The first and third panels contain the main 5000-volt switches, of the bayonet stick type, for connecting the line to one of the synchronous motors. The lower sub-panel of the first contains the synchronizing lamps and switch, while similarily situated on the third panel is a double-pole double-throw switch for exciting the fields from either of the two exciters. For synchronizing purpose one lamp only is required, but as the machines are coupled when the lamp is bright, two other lamps are placed alongside always lighted to prevent accidents which might occur should one of the main connections be broken, in which case the synchronizing lamp would be bright and remain so. The fourth and fifth panels of each set contain the four 1000-volt switches, also of the bayonet stick type for the starting two-phase induction motor.

Situated at the opposite end of the same gallery is the railway switchboard (Fig. 3) of five panels, also of white marble. It is practically the standard G. E. railway switchboard with, perhaps, the distinctive feature of containing a Thomson integrating wattmeter to measure the power required by the street railway. There are also two Bristol recording instruments, one a voltmeter the other an ammeter. The latter shows how the load on the street railway varies.

The framework of this switchboard gallery is of iron I-beams on which a slate floor is laid. A perfectly insulated railing extends all

along the front of the gallery, while for further insulation a rubber mat covers the slate floor completely.

Returning to the opposite side of the station, the arc light switchboard is situated at the end of the gallery. It is of the standard Brush type built of enameled slate with connections for 12 circuits. Of these 12 circuits, 11 are for street and commercial lighting, the other being used to light the substation. Incandescent pilot lamps are placed immediately over the switchboard, while in the intervening space between these and the ceiling are 24 Thomson magnetic blowout lightning arresters in three rows.

A 10-ton hand crane runs the whole length of the substation. All machine terminals and high tension lines crossing the interior are placed in ducts in the floor, separate ducts being used for each machine, all covered with neat iron plates. For the 16 5000-volt cables two small iron racks covered with insulating tape are used, one on each side of the duct. Small shelves project out, each of sufficient width to hold two cables. In this manner insulation is not endangered, which would be the case were the cables piled promiscuously in the duct. All high tension cables are Habirshaw brand, of stranded copper wire equal to No. 0, rubber covered and double wrapped, the insulation being 3-16 inches thick. At present this company has the sole control of all electric power and lighting in the city of Quebec. For light they charge ¾ cent per lamp hour of 16-cp 55 watts, which is equal to 13½ cents per kw-hour. A flat rate is charged for power, depending on the service required.

STREET RAILWAY.

Not many years ago, any one who had prophesied that a street railway could be operated in the city of Quebec would have been laughed at. Nevertheless to-day there is an electric railway operating most successfully and that, too, every day of the year. The difficulties were numerous, principally on account of the heavy grades encountered in rising from lower to upper town, and also on account of the narrow and crooked streets in the older portions of the city. Some of them are tortuous enough to puzzle a London or Boston policeman.

Sixteen miles of single and double track have been laid. The heaviest grade is one of 15¼ per cent. with a 40-ft. radius curve at the top, half the curve being on the hill itself. Curves of 35 ft. radius are quite common, while in some places it is necessary to use a reverse curve to turn a corner. A heavy grade has been overcome in one out-of-the-way place by building a steel trestle-work.

Notwithstanding that 120.6 inches of snow fell last winter, of which 44 inches were in the month of March, the street railway operated continuously.

The equipment of the Quebec District Railway consists of 24 open and 38 closed cars, and 6 sweepers, all built by the Ottawa Street Railway Company. The trucks were built by the Taylor Electric Truck Company, Troy, N. Y. The motors and controllers are all Westinghouse apparatus supplied through the Westinghouse Canadian agents, Ahern & Soper, Ottawa.

SUBURBAN RAILWAY.

Besides controlling the street electric railway, the same company owns a steam railroad running to St. Ann's, a distance of 21 miles. This is being converted into an electric road and is to be extended 9 miles, and a branch line 6 miles long built. The cars are to be 55 ft. over all, similar to the Detroit, Ypsilanti ones and run by four 50-hp Westinghouse motors capable of speeding 50 miles an hour. The cars will all be equipped with the Westinghouse air brake. The service will be hourly at the beginning, but it is expected that there will be enough traffic to justify a half-hour service during the summer months. It will probably be operating next summer.

For feeding this road one 600-kw Westinghouse double-current generator is to be installed at Montmorency Falls. The direct-current side is to be 550 volts, which will feed directly into the trolley line for several miles on either side of the Montmorency Falls, as they are on the line of railway. The alternating current is to be delivered at a nominal pressure of 400 volts, two-phase, which is to be transformed by two 125-kw transformers to 11,000 volts three-phase by means of the "Scott Connection." This will be transmitted to a substation 10 miles from the far end of the road, where it will transformed down to two-phase again and run a 200-kw Westinghouse rotary converter, whence direct-current at 550 volts will be obtained to feed all intermediate and exterior points of the line.

Before closing the writer desires to express his thanks to Mr. E. A. Evans, general manager and chief engineer, to Mr. Lewis Burengineer, for many courtesies and valuable aid.

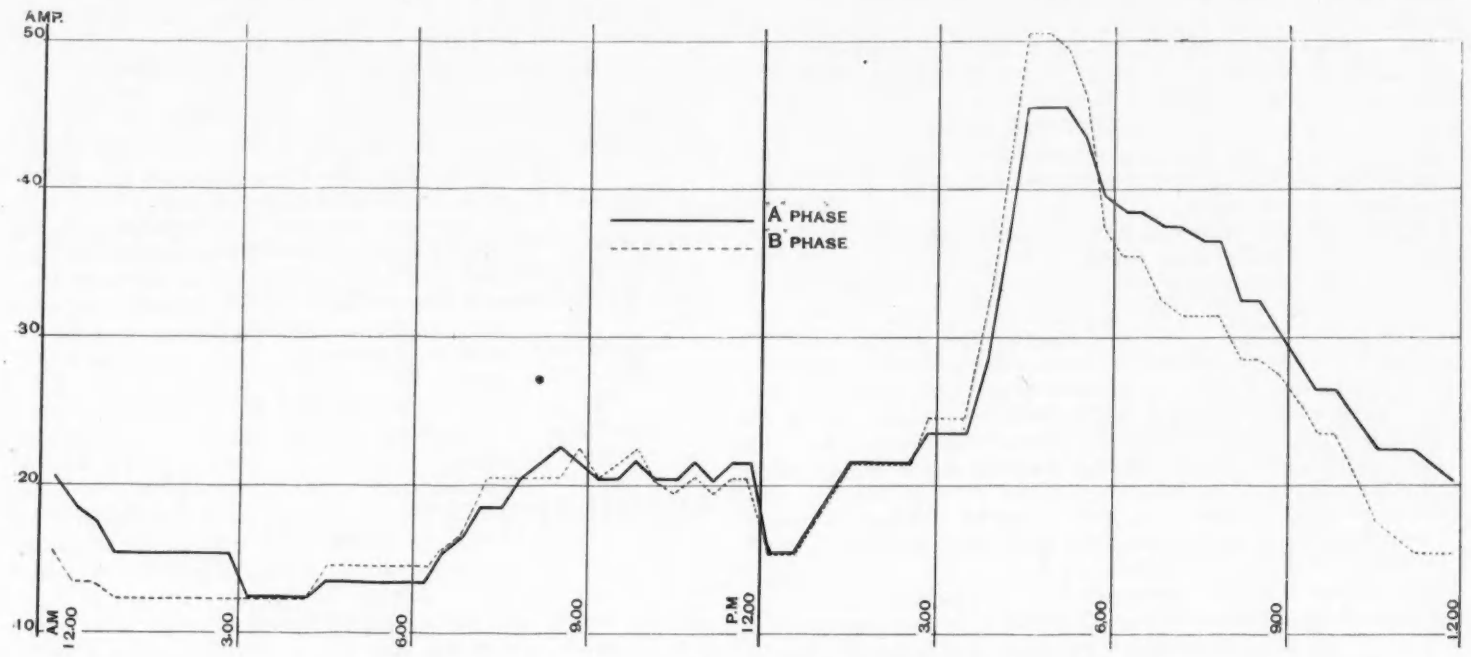


FIG. 7.—AMPERE SHEET—THE MONTMORENCY ELECTRIC POWER COMPANY.

Detroit's Municipal Street Railways.

The Street Railway Commission has petitioned the Common Council for two ordinances. One asks for a franchise for the Municipal Railway Company, really the commission, to operate street cars over all the existing lines at a straight 3-cent fare. The other asks for a security franchise which shall secure the bonds issued by the municipal company to the old company. The purchase price is in round numbers $16,000,000, and the security franchise stipulates that in case the new company defaults, the lines shall revert to the old company, with a thirty-year franchise from the date of such reversal, and that the rates of fare to the company to which the roads revert shall be five cents and six tickets for a quarter. This move is to get around the question of the constitutionality of the law under which the commission was appointed, and it stipulates that in case the Supreme Court holds that the city cannot own and operate street railways the Common Council shall have the power to grant the franchises asked.

Relation Between Armature and Line Currents in Polyphase Transmission.

BY PROF. HENRY S. CARHART.

THE following graphical method was devised for elucidating the relative phases and magnitudes of the currents flowing in adjacent connected circuits of a polyphase generator and in the line when the system is balanced. It is not assumed that any new results are reached, but it is thought that the analysis serves to

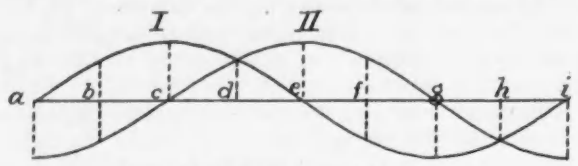


FIG. 1.—TWO-PHASE CURRENTS.

make clear several relations which remain obscure in the minds of most students.

First, two-phase currents. Fig. 1 represents the currents flowing in the two transmission lines, I and II. Assume a maximum value of 100 amperes for definiteness. The effective or square-root-mean-square value is then 70.7. The ordinates *a*, *b*, *c*, etc., are drawn 45° or one-eighth of a period apart. At the instant represented by *a*, current II has its maximum negative value; at *b*, currents I and II are numerically equal and the value of each is 100 sine 45°, or 70.7 These values are repeated with changes of sign throughout each period.

Fig. 2 shows the direction of the four armature currents corresponding to the ordinates *a*, *b*, *c*, etc., in a bipolar field, or when the number of poles of the armature is equal to the number of the field plus two. The positive direction of the line currents is upward for I and from left to right for II. In the armature the positive direction is clockwise, and the segments are numbered 1, 2, 3, 4, in the same direction, as in *a* of Fig. 2.

At *a* current I is zero and II has its maximum negative value. The 100 amperes then divide equally between the two halves of the armature. At *b*, I is positive and II negative, each having the value of 70.7 amperes. There is then no potential difference between the ends of sections 2 and 4, and equal currents flow through 1 and 3, negative in the former and positive in the latter. The remaining diagrams of the figure show the currents in the four sections of the armature at instants corresponding to the other ordinates of Fig. 1. The following table exhibits the values and signs of the four currents at successive intervals differing from one to the next by one-eighth of a period:

TABLE I. SUCCESSIVE VALUES OF ARMATURE CURRENTS.

	I_1	I_2	I_3	I_4
a	−50	+50	+50	−50
b	−70.7	0	+70.7	0
c	−50	−50	+50	+50
d	0	−70.7	0	+70.7
e	+50	−50	−50	+50
f	+70.7	0	−70.7	0
g	+50	+50	−50	−50
h	0	+70.7	0	−70.7

If now we plot the numbers in each vertical column we shall obtain the curves of the currents in the four segments of the armature.

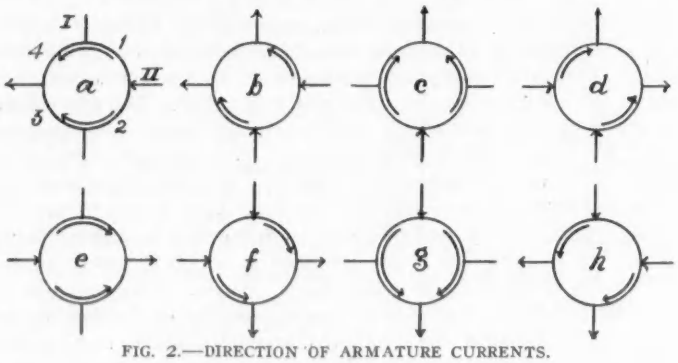


FIG. 2.—DIRECTION OF ARMATURE CURRENTS.

These curves are shown in Fig. 3. The currents in adjacent segments, as 1 and 2 or 1 and 4, differ in phase by one-quarter of a period, as they evidently should; while currents in opposite segments are opposite in phase.

Moreover, the maximum value for each current is 70.7, or the effective value is $70.7 \times 0.707 = 50$. The current in either external circuit is then $\sqrt{2 + 5^2} = 70.7$, which corresponds to a maximum of 100.

By a comparison of iFgs. 1 and 3, it will be seen that current I, which reaches its maximum at the ordinate *c*, is 135°, or three-eights of a period ahead of current I_1 and one-eighth of a period ahead of I_4. But if I_1 be reversed in direction, IT will be the resultant of I_1 and I_4 and will differ from both by one-eighth of a period. Thus in Fig. 4, OA represents I, OB I_4, and OC I_1. A study of Fig. 2 will show that the instantaneous current flowing out of the armature by any conductor is the algebraic *difference* between the corresponding

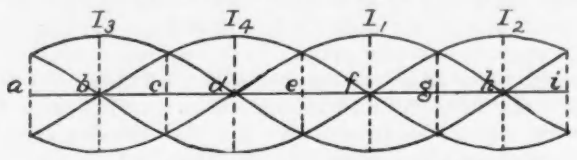


FIG. 3.—CURRENTS IN FOUR SEGMENTS OF ARMATURE.

currents in the two adjacent segments. Thus in *a*, current I is zero, and the currents in the adjacent segments are equal and of the same sign. Their algebraic difference is therefore zero. In *b*, I_1 is negative and I_4 zero. Hence I is O — I_1, or I_1. In *c*, I_1 and I_4 are equal and of opposite sign, and I is the arithmetical sum or the algebraic difference of the currents in segments 1 and 4. To find the effective resultant of the currents in two adjacent sections, it is necessary to reverse one of them and then to add them geometrically. This reversal is of course equivalent to the minus sign of the algebraic subtraction.

Second, three-phase currents. The last point described above is more strikingly illustrated by Figs. 5 to 8, relating to three-phase currets. Fig. 5 has ordinates *a*, *b c*, etc., drawn 30° or one twelfth of a period apart. At *a* I and III are equal and their sum is the same as II and of opposit esign. The currents at this instant divide in the armature, as shown in Fig. 6a, where II is negative and I and III are positive. An outward flowing current is positive. At *b*, III is zero and I and II are numerically equal. Current flowing out of I and in at II divides in the armature, one-third going around through segments 2 and 3 and two-thirds through segment I, the first two in the positive direction and the last in the negative. For *c* the case is similar to *a* and for *d* it is similar to *b*. Hence the instantaneous currents for the eight ordinates of Fig. 5 are exhibited by the eight circular diagrams of Fig. 6.

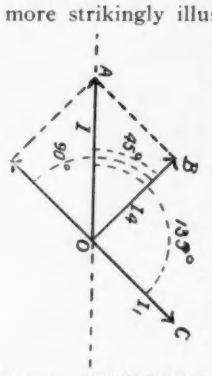


FIG. 4.—COMPONENT AND RESULTANT CURRENTS.

If now the external currents have a maximum value of 122.5 amperes, or an effective of 86.6, then at *a*, I and III are 61.25 amperes

TABLE II. SUCCESSIVE VALUES OF ARMATURE CURRENTS.

	I_1	I_2	I_3
a	−61.25	+61.25	−61.25
b	−70.7	+35.4	+35.4
c	−61.25	0	+61.25
d	−35.4	−35.4	+70.7
e	0	−61.25	+61.25
f	+35.4	−70.7	+35.4
g	+61.25	−61.25	0
h	+70.7	−35.4	−35.4
	etc	etc.	etc.

and II is 122.5. At *b*, current I is $122.5 \times \sin 60°$ or 106.1; II is — 106.1. Hence I_2 and I_3 are one-third of 106.1 or 35.4, and I_1 is

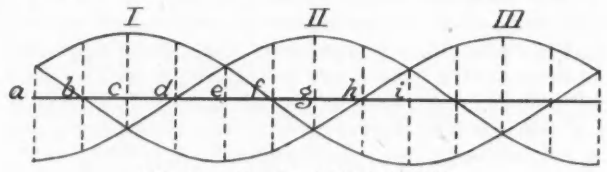


FIG. 5.—THREE-PHASE CURRENTS.

— 70.7. We may now tabulate the eight successive values of the three armature currents as in Table II.

Plotting the numbers in the three vertical columns, we obtain the

three sine curves of Fig. 7. The maximum value of each is 70.7, or the effective value is 50.

In Fig. 5, I has its maximum value at *c*. Fig. 7 shows that I_1 reaches its maximum at *h*, or 150° behind I. Also I_3 is a maximum at *d*, 30° behind I. These relations for either maximum or effective values are shown in Fig. 8. Moreover, the instantaneous values of I are the algebraic difference of I_3 and I_1, as shown in Fig. 6, re-

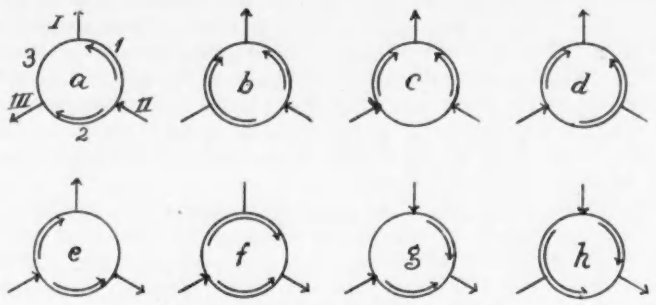


FIG. 6.—DIRECTION OF ARMATURE CURRENTS.

membering that the positive direction is clockwise and the negative counter-clockwise. Hence to combine I_1 and I_3 effective geometrically, reverse I_1, as in Fig. 8, and I is their resultant. In order therefore to find the effective resultant of two adjacent three-phase currents, one of them must first be reversed in direction, giving two components 60° apart to combine into the resulting external current.

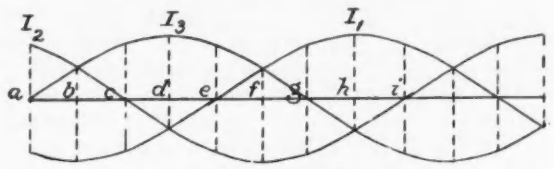


FIG. 7.—CURRENTS IN THREE SEGMENTS OF ARMATURE.

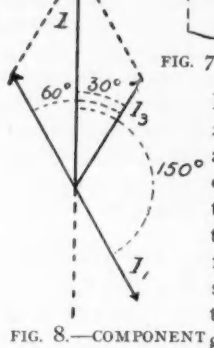


FIG. 8.—COMPONENT AND RESULTANT CURRENTS.

In the present case each external current is thus $2 \times 50 \cos 30°$, or 86.6. When the currents in adjacent armature sections have the same sign, or flow in the same direction around the armature, the current through a conductor joined to the junction of the two sections must be the difference of the two; and if they have opposite signs, it must be the arithmetical sum of the two. The effective value is therefore the goemetrical sum of the effective values of the two adjacent aramature currents, the lagging one being reversed in direction.

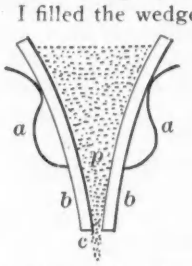
A Novel Coherer.

By Alfred G. Dell.

Although there is a great number of different kinds of coherers, I present herewith a description of another one.

The figure will explain its construction. I made it of thin pieces of wood in the shape of a wedge. *b* represents two opposite sides, and *a* are stiff brass wires, passing through the two opposite sides into the filing. *p* represents the two opposite points.

I filled the wedge full of fine brass filings, and started them passing the two points *p* and out at *c*. In passing the point *p*, I supposed they would naturally break the connections made by the sparks in an instant and completely, and the fillings would conduct only while sparks were passing. I found it appeared to accomplish the above, but I could not keep it running without frequently starting it by tapping or shaking.



A NOVEL COHERER.

From my experiments with it, I believe, it is possible to construct one out of glass that would act without any tapping. I would suggest one made like the old hour glass ,that can be turned over when one end is empty. There would have to be two opposite electrodes in ach end near the division tube, making a pair of double electrodes. I have not the facilities to construct such a coherer, and leave it to others to try it, if they wish.

Some Methods of Measuring High Potentials With Low-Potential Instruments.

By Prof. Samuel J. Barnett.

IN the course of a certain electrical investigation[1] necessitating the use of changes at potentials of many thousand volts, it devolved upon the writer to develop some means of measuring these potentials with instruments constructed for low-potential measurement; the result being that some methods were devised by which the range of an electrometer or ballistic galvanometer may be almost indefinitely extended. As the methods are capable of accuracy, and as it is frequently desirable to measure high potentials in laboratories where specially constructed instruments are not available, it is hoped that this paper may be found useful.

The first method, which was adopted for the investigation men-

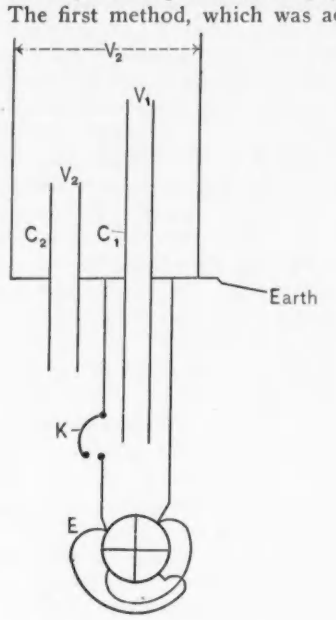


FIG. 1.—FIRST METHOD.

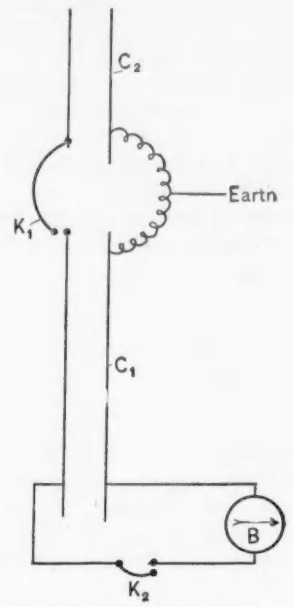


FIG. 2.—SECOND METHOD.

tioned, consists in applying the whole potential difference in question to the terminals of two condensers arranged in series, and measuring the fall in potential through the plates of one of them. From this and the known ratio of capacities the whole potential difference immediately follows. Thus, let C_1 and C_2 (Fig. 1) denote the condensers (and their capacities) in series, and having the joint capacity C. Let the electrometer E be connected to the plates of C_1, the terminal plate of which is earthed; and let V be the whole fall of potential through the series, and V_1 that through C_1. Then we have, including in C_1, the capacity of the electrometer:

$$CV = C_1 V_1 = \frac{C_1 C_2}{C_1 + C_2} V; \text{ where } V = V_1 \frac{C_1 + C_2}{C_2}.$$

By choosing the ratio $\frac{C_1 + C_2}{C_2}$ in a suitable manner, an electrometer (or ballistic galvanometer) of any convenient range may be employed to measure any e. m. f. within its range or higher, except in so far as leakage, absorption, etc., render its indications unreliable. With ordinary condensers these difficulties, especially troublesome at high potentials, may be largely overcome by performing all operations quickly; while absorption may be entirely eliminated by the use of air condensers. If an electrometer, connected idiostatically, is used, alternating as well as direct e. m. fs. may be measured, care being taken, of course, to use the proper ratio of capacities for the frequencies employed. In the experiments above mentioned, the ratio $\frac{C_1 + C_2}{C_2}$ was 75 to 1, enabling a Kelvin quadrant electrometer to measure potential differences greater than 30,000 volts. A comparison of the readings of the instrument with Baille's values for a number of spark-length potentials, showed a very satisfactory agreement.

After this method was developed the writer found that the well known principle which it involves ($V = V_1 + V_2 + V_n$, for condensers in series) had long been used by Lord Kelvin in the

[1] Physical Review, 6257, 1898.

calibration of his electrostatic voltmeters, by the series *production* of high potentials.[2] This, however, is quite different from the method just given of *measuring* potentials produced in any manner.

The second method is an inversion of Faraday's method of comparing capacities. In this well known method the difference of potential between the plates of the first condensers is measured; the second condenser (uncharged) is then connected in multiple with the first, and the resulting difference of potential measured. From these data the ratio of the capacities is readily obtained. If, however, the ratio of the capacities is known, the initial potential difference to which the condenser has been charged by the source whose potential difference is required, may be computed from the measurement of the final; and this may be made as small as desired by a suitable selection or adjustment of the condensers to be used. Thus, C_1 and C_2 (Fig. 2) are two condensers (and their capacities) which can be put in multiple through the switch K_1; the terminals of an electrometer, or better (with ordinary condensers and high potentials at least) a ballistic galvanometer, B, can be connected with the coatings of C_1 through the switch K_2. The potential difference to be required, V_1, is applied to the plates of C_2. C_2 is then insulated and immediately put into multiple connection with C_1, reducing the potential difference to V_1, whereupon the condensers may be instantly discharged through the galvanometer, B, by the switch K_2. If an electrometer is used instead of the galvanometer, it may be left connected to C_1 until just after the condensers are put in multiple, when it should be insulated, unless the condensers are non-absorbent. In many cases the galvanometer may be left permanently connected. In this method we have

$$C_2 V = (C_1 + C_2) V_1; \text{ whence, as before } V = V_1 \frac{C_1 + C_2}{C_2}$$

If a galvanometer is used, C_1 and C_2 must both be known, in addition to their ratio. From $C_1 + C_2$ and the galvanometer constant and deflection, V_1 is readily found, and consequently V. This method possesses a great advantage over that first described in that it avoids, almost completely, the troublesome effects of absorption and leakage, the whole process of arrangement in the multiple and final discharge being practically instantaneous. If non-absorbent condensers are used, however, and leakage is negligible, the first method possesses the advantage of permitting the measurement of continuously varying potentials.

The writer has not been able to find that either of the methods given here has been described by others. He found after devising them, however, that the first had occurred to two members of the Department of Physics at Cornell University; and both are so simple that they can hardly fail to have occurred to many others.

In addition to the two modes of arrangement given above, Mr. H. J. Hotchkiss has suggested and roughly tested, a Wheatstone bridge arrangement of the condensers. This arrangement has also been used, as is now well known, for the comparison of capacities. In fact, any electrometer method of comparing capacities may be invented for the comparison of potentials.

The World's Coal Production and Consumption.

The coal production and consumption of the world during the past fifteen years are presented in some tables just prepared by the Treasury Bureau of Statistics. These show that while the United Kingdom is still the largest coal producer of the world, the United States is a close second, and if the present rate of gain is continued will soon become the leading coal producing country in the world. The coal production of the United Kingdom in 1897 was 202,000,000 tons, that of the United States 179,000,000 tons, Germany 91,000,000, France 30,000,000, Belgium 22,000,000, Austria-Hungary 12,000,000, Russia nearly 10,000,000, Australasia nearly 5,000,000, Japan over 5,000,000, British India 4,000,000, Canada nearly 4,000,000, and Spain 2,000,000, while no other country reached 1,000,000 tons in production. The United States, however, has gained much more rapidly during the fifteen years under consideration than has the United Kingdom or, indeed, any of the important coal producing countries of the world, her gain during the fifteen years being over 73 per cent., and that of the United Kingdom less than 24 per cent. As an exporter of coal, however, the United States takes low rank in proportion to its production and stands fourth in the list of coal exporting countries. France is the largest coal importing country. Great Britain is the largest consumer of coal in proportion to population.

[2] Proc. B. A. A. S., p. 90, 1885.

Three-Phase Four-Wire Low-Tension Systems.

By A. J. BOWIE, JR.

THE system here considered is a low-tension, three-phase "star" distribution from central stations, or sub-stations, feeding a network of mains. The voltage delivered to the mains is about 200 volts between legs—that is 115 volts between the neutral and any of the three legs. When the station is located very near the centre of a large lighting territory, it will sometimes pay to put in such a system, and thus save the expense of transformers on the lines for the districts lying near the station. Motors can be run on the three legs when desired; the lights, however, being connected between the neutral and any of the three legs. The system is analogous to the Edison three-wire system, though possessing many points of difference.

To give an idea of what may occur in such a system, the following is a description of a plant on which some tests were made. Seven sets of feeders (three in a set) were run from the station. The feeders were of No. 0000 wire, and were arranged on regulation six-pin cross arms, each set being by itself on one side of a cross arm. The lengths of the feeders varied from about 1500 ft. to 3400 ft., and each feeder was furnished with a regulator, one terminal of the voltage coil of which was connected to the neutral. The range of the regulators was 10 volts in each direction. One No. 0000 wire ran from the neutral at the station to the mains, the neutral also being grounded at the station and at each place on the mains where the feeders ended. The mains were of various sizes, from No. 000 to No. 4 wire; in most places being entirely too small to tie the feeders together properly. The balance on the mains was very poor, though the total amperes of the systems were very fairly balanced—the current returning to the neutral being very small. The amperes per leg were about 800 at a maximum, at the time the tests were made. The load at that time was composed almost wholly of incandescent lights, so that the power factor at the mains was high. The frequency was 60 cycles per second. The position of the feeders on the poles when leaving the station is shown in the record of the tests. None of the feeders were spiraled. Pressure cables containing four wires each were run for each set of feeders. At full load it was almost impossible to keep the voltage on the mains, anywhere nearly correct, the drop in some feeders being execessive and in others being entirely too small. This was due to three causes:

1. The drop in the neutral due to bad balancing—the overloaded leg tending to drop and the others to rise. 2. The effect of self-inductance of the feeders. 3. The mutual induction. The following is an account of a test which was made one night at full load:

The observations which were taken simultaneously for each feeder were: 1. The current. 2. The voltage between the feeder and neutral where leaving the station. 3. The voltage on the mains at the end of the feeders, between the neutral and the feeder in question, this being taken by the pressure cable. 4. The geometrical drop in the feeder itself, on the assumption that the neutral wire was at the same potential at all points. This was taken by using a 1:1 transformer on voltage No. 2 and by connecting the secondary of the transformer in opposition to voltage No. 3.

In the tables the following quantities are recorded: 1. Current. 2. Calculated CR drop. 3. Calculated geometrical drop. 4. Observed geometrical drop. 5. Algebraic drop in the feeder (by calculation). 6. Algebraic drop in the feeder (from observations). Hereafter the algebraic drop will be called simply the drop.

No. 3 and No. 5, are calculated on the assumption that there was no mutual induction, and that the three wires of one set of feeders were carrying currents equal to that of the feeder in question, and were on an equilateral triangle, 18" between centres. These assumptions, of course, are not true, but if the effects of inductance were all taken into account, the problem would be extremely complicated. No. 5 is calculated first on the assumption of a power factor of unity, and then assuming it to be .98 at the mains.

From the figures in the tables it is hard to draw any definite conclusions, except that the balancing and the self and mutual-inductance were responsible for most of the trouble. The small size of the mains also had a great deal to do with the case, as the feeders were not properly held together.

Changing the arrangement of the wires on the pole on leaving the station had some effect on the results, but did not improve matters much, merely changing the trouble around. However, by spiraling the feeders, arranging them so as to be mutually non-inductive,

regulation was made easier even though the loads did not balance. Next the size of the mains was increased, so that the feeders were tied together with No. 0000 or No. 00 wire. This was a great improvement, and although the regulators were rewound so as to give twice the ampere capacity, and hence only half the voltage range, still with a total output of 1000 amperes per leg, the board was easy to handle. Proper balancing was also a decided improvement.

Before any changes were made in the system, it was necessary to pull out some of the feeder switches, even at full load to prevent the voltage from running too high. Owing to the small mains, this caused violent flickering in the lights.

In one instance, an indicating wattmeter placed on one of the feeders showed that more power went into the mains than left the station. There was a current of about 100 amperes flowing in the feeder at the time. This result was probably in part caused by a rise in the neutral wire at the end of the line, due to unbalancing. The necessity of spiraling the wires on a pole to avoid mutual induction and also unequal self-inductance of the feeders, depends on circumstances, and increases with the following quantities, all other things remaining the same:

1. Frequency. 2. Increased *CR* drop. 3. Decreased distance apart of different sets of feeders and increased distance apart of the wires of one set. 4. Decreased power factor at the mains. 5. (For a given *CR* drop), with increased size of wires. It is often possible to do a good deal of useless work by putting spirals in the lines when unnecessary. The more such work can be avoided, the greater the simplicity of the system.

For a system of this sort to give the best service, it is important that the drop in the lines for a given current, shall be as low as possible, so that the voltage may be steady, and the switchboard not require too much attention. To see the bearing of the different factors on the problem, it is best to take a special case. Suppose one set of feeders of No. 0000 wire arranged on an equilateral triangle, or arranged in a straight line, and spiraled so as to be equivalent to being on the same triangle. Suppose they are not affected by induction from other wires, and suppose the load balanced. Let 100 volts on each leg of the "star" be delivered to the mains, and let the *CR* drop be 10 volts on each wire. Suppose the plant is run at 60 cycles. Table I shows what results will be obtained under these conditions.

TABLE I.—DROP AND LAG FOR DIFFERENT LINE DISPOSITIONS.

Power factor.	15-in. triangle.		7½ in. triangle.		1-in triangle.	
	Drop.	Lag.	Drop.	Lag.	Drop.	Lag.
1.00	11.8	10¾°	11.2	9°	10.2	4½°
.90	18.7	32¾°	17.0	31⅜°	12.5	27¼°

The effect of not spiraling the three feeders of one set, but leaving them equidistant, on a straight line, is to cause unequal drops in them, and provided the station voltages are such as to deliver to the mains an equilateral voltage triangle with the neutral at the centre, and provided also the three currents when delivered are

TABLE II.—WIRES 12 INS. APART.

Power factor.	C Leg.		B Leg.		A Leg.	
	Drop.	Lag.	Drop.	Lag.	Drop.	Lag.
1.00	14.6	10⅝°	11.6	10°	9.0	11⅛°
.90	21.3	32¼°	18.1	32¼°	16.6	33⅝°

equal and have the same lag angle, then if there is no drop in the neutral, the three voltages forming the "star" at the station, will not only be unequal, but also will differ from each other by angles other than 120 degrees. In other words, it will be impossible to deliver to a balanced load on the mains, an equilateral triangle of

TABLE III.—WIRES 6 INS. APART.

Power factor.	C Leg.		B Leg.		A Leg.	
	Drop.	Lag.	Drop.	Lag.	Drop.	Lag.
1.00	14.2	9°	11.1	8½°	8.6	9½°
.90	19.8	31°	16.5	31°	14.9	32¼°

voltages, with the neutral at the centre, if the voltages from the legs of the "star" to the neutral, where the wires leave the station, are 120 degrees apart.

To show the effect of such an arrangement, Tables II and III were obtained graphically, by supposing the same conditions as in the Table I, except that the wires are in a straight line, and not spiraled—the wires furthest apart being twice the distance, as given below. Also the neutral at the mains is supposed to be at the centre of the equilateral triangle of voltages delivered to the mains.

In these tables, the *B* leg is supposed to be the centre wire, and the order of rotation to be *A C B*, at the generators. In the cases considered, the lag recorded is the total lag of the current behind voltage at the station. The difference in the lags of the different feeders for any one case is seen in the instances considered, to be small, but there is quite a difference in the drops of the different feeders, showing practically what voltages would have to be given to the feeders by the regulators.

The main points to be watched, for the successful operation, of such a plant as the one described, are as follows:

1. The mains should be large, so as to tie the feeders together properly. 2. Arrange the feeders so as to avoid mutual induction. 3. Avoid unequal self-inductance (where such is apt to be of any importance), by proper arrangement of feeders. 4. The power factor of the load should be as high as possible. It will sometimes pay to put loads with low power factors, which do not go off at full load, on the high tension system. The same thing applies to large loads which it is impossible to balance, which may go on or off suddenly. This can often be conveniently arranged, as the primary wires of the high tension often run through the low tension district. 5. A good balance should be obtained. 6. The regulators should have ample range to allow for any unbalancing which may occur.

It is evident that the nearer together the feeders of a set are placed, the less will be the volts drop in the same; consequently, to give the best results, the feeders should be arranged in a cable. When the wires are strung on poles, a good way to get rid of mutual induction is to place the feeders of one set as near together as possible, and to place the different sets as far apart as possible. Then put two spirals in each set of feeders; that is to say, one complete revolution, spiraling the adjacent feeders in opposite directions. While this may not wholly overcome the mutual induction, it will do so to a great extent, and it will overcome any effect of unequal self-inductance, provided the load is balanced.

With the wires of a set one foot apart, as ordinarily arranged, a comprehensive system of spiraling will involve chopping some of the feeders up into very short lengths, and is consequently very undesirable, if it can be avoided.

A comparison of the four-wire alternating system with the direct-current Edison three-wire system brings out the following points:

Good balance and large mains are of more importance with the alternating system, which is likewise harder to balance, as the load must be divided into three parts instead of into two. All troubles from inductance and low power factor are avoided with direct-current. Allowing for a high power factor, such as would probably be obtained with an incandescent load, the efficiency of the two systems would be about the same. However, the voltage drop is greater in the alternating, thus requiring more attention to the switchboard. Still, the regulators of the alternating offer a means of more gradual and simple adjustment than can be attained with direct-current.

If the current delivered to a substation is alternating, as would probably be the case, then for the direct-current system, it would be necessary to install rotary converters, in addition to the other apparatus. Besides the first cost, there would be the additional loss of power in the rotaries, as well as the cost of operation and repairs. The use of storage batteries is naturally in favor of the direct-current.

To compare the four-wire low-tension system, with a transformer distribution, suppose current delivered to a substation at such a tension that it necessitated substation transformers for any distributing system. In that event, equal substation transformers would have to be bought for any sort of distribution. In general, it will be necessary to have a high-tension system for the outlying districts, so that installing a low-tension system involves splitting the service up, which is usually not desirable. It also involves several panels of switchboard, as well as instruments and regulators. Besides these, the largest expense is the copper for the feeders and pressure cables; also, there is the attendance necessary to regulate the pressure. If the load does not change too suddenly, good regulation is possible. The low tension saves all line transformers, and it also has the advantage of making a unit of that part of the system.

The full load efficiency will usually be in favor of the transformer distribution, which also has the advantage that so good a balance is unnecessary, and that a sudden change of a large load, even if it be on one leg, will not affect the voltage as much as in the other

system. A load with a low power factor, such as motors or alternating arc lamps, does not make nearly so much difference with the transformer system, since the primary volts loss is very small in comparison with the low-tension system.

TABLE IV.—RECORD OF TESTS.

	Leg.	C	B	A	C	A	B	
No. 1.	Amperes	90	50	80	88	110	90	No. 2.
	C. R. Drop...	15	8.3	13.3	11.2	14	11	
	Cal. Geom. Drop	35	19	31	26	33	27	
	Obs. Geom. Drop	36	27	43	16.5	47	31.5	
	Cal. Drop P. F. 1.00.....	19	10	16	13	18	14.5	
	Obs. Drop...	30	..	29	9	35	13	
	Leg.	C	B	A	B	C	A	
No. 3.	Amperes	85	121	104	80	80	68	No. 4.
	C. R. Drop....				8.6	8.6	7.3	
	Cal. Geom. Drop.....				21	21	18	
	Obs. Geom. Drop.....	16	23.5	35	28 5	12.5	19.5	
	Cal. Drop P. F. 1.00.....				10	10	8	
	Obs. Drop....	8	12	28	8	7	9	
	Leg.	C	B	A	C	A	B	
No. 5.	Amperes.....	97	80	90	75	93	90	No. 6.
	C. R. Drop...	14.3	11.8	13.3	9.6	11.9	11.5	
	Cal. Geom. Drop.....	34	28	31	23	28	27	
	Obs. Geom. Drop.....	29.5	27	41	15	32.5	30.5	
	Cal. Drop P. F. 1.00.....	18.5	15	16.5	12	15	14 5	
	Obs. Drop....	27	6	30	7	27	16	

	Leg.	C	B	A
No. 7.	Amperes	85	121	103
	Obs. Geom. Drop.....	13	27.5	29
	Obs. Drop	0	13	6.6

In the following test taken some weeks later the arrangement of wires on the pole where leaving the station, was altered, as indicated in the table.

TABLE V.—RECORD OF TESTS.

	Leg.	C	B	A	C	B	A	
No. 1.	Amperes.....	100	55	84	95	140	125	No. 2
	C. R. Drop....	16.7	9.2	14	12.2	18	16	
	Cal. Geom. Drop.....	40	22	32	29	43	38	
	Obs. Geom. Drop.....	41	31	41	27	52	48	
	Cal. Drop P. F. 1.00.....	21	11	17	15	23	20	
	Cal. Drop P. F. .08.....	27	14	22	20	29	25	
	Obs. Drop.....	30	4	25.5	3	35	35	
	Leg.	A	C	B	A	C	B	
No. 3.	Amperes.....	110	104	114	112	102	80	No. 4.
	C. R. Drop..	..	..	..	12.2	11.1	8.8	
	Cal. Geom. Drop.....	..	..	..	29	26	21	
	Obs. Geom. Drop.....	37	24	32	32	21	32	
	Cal. Drop P. F. 1.00.....	..	..	..	15	14	10	
	Cal. Drop P. F. .08.....	..	..	..	19	18	14	
	Obs. Drop....	23.5	15	19.5	24	5.5	5.5	
	Leg.	B	A	C	B	A	C	
No. 5.	Amperes.....	78	95	80	122	107	90	No. 6.
	C. R. Drop..	11.6	14.1	11.9	15.6	13.7	11.5	
	Cal. Geom Drop.....	27	33	28	37	32	27	
	Obs. Geom. Drop.....	30	43	25	46	31	27	
	Cal. Dron P. F. 1.00.....	14	18	15	19	17	14	
	Cal. Drop P. F. .08.....	18	23	19	25	22	18.5	
	Obs. Drop....	3	26.5	14.5	28.5	24	4.5	

	Leg.	C	B	A
No. 7.	Amperes	102	135	110
	Obs. Geom. Drop	21	39	29
	Obs. Drop	1	24	22

In many cases it is doubtful whether a low-tension four-wire system will pay, transformers usually being preferable, for the reasons given above. Should high voltage lamps improve in efficiency, and the wiring in the houses be good enough to use 230-volt lamps, so that a low tension at 400 volts between the legs of the "star" could be used, then this system, would have a large field opened up to it.

Feeders No. 3 and No. 7 were tied together about 1200 ft. from the station, hence the drops in them cannot be figured. Feeders No. 2 had larger boosters than those of the other feeders. Later, the same evening that these last tests were made, the amperes on No. 2 had fallen to the following values: $C = 90$; $B = 105$; $A = 120$; and the drops in the lines were: $C = 4$ volts; $B = 17$ volts; $A = 35$ volts. The voltage delivered to the mains was 120 volts from the neutral to each of the legs. The wires were not spiraled in either of these tests.

Electrical Notes in China—I.

By Prof. Francis B. Crocker.

IT is customary to link the Chinese with the Japanese in our thoughts and statements, but on closer acquaintance we find they have very little in common except the obliquity of their eyes. In manners and customs the Japanese are much more like the French than they are like the Chinese, and the latter in their non-progressiveness as well as self-satisfaction resemble the Turk, but therein differ as much as is possible from their near neighbors. The contrast could not be illustrated better than by comparing the status of electrical affairs in the two countries. China is extremely backward, while Japan is already abreast of most of the other nations, and in her *rate* of advance is equal to any except the United States. At the outset I will confess to having rather a strong prejudice against the Chinese. It is feeble, however, compared with its cause —the vile sights and odors that constitute a Chinese town.

The telegraph is the only electrical application that has been developed to a state of any importance in China, and even this is still quite primitive. The internal telegraph system is operated by the Imperial Government largely for its own purposes, but is available also for commercial and private messages. The number of lines is limited, but this service is supplemented by the submarine cables, which connect the principal ports of China with each other and with Europe. These cables are independent of the Imperial Government, being owned and operated by the so-called "Eastern Extension Company."

The fact that these lines are submarine and only come ashore at the treaty ports, where they are directly under foreign jurisdiction, protects them from interruption due to hostility of the Government or the natives individually. Even in the case of the Imperial telegraph system great difficulty is experienced on account of the dogged opposition of the people to anything that is new or foreign. They cut down the poles, break the insulators and remove the wire. In some cases it is not altogether fanaticism on the part of the natives, as they incidentally do themselves a good turn by using the poles for firewood and the wire for various purposes. It is found that copper wire is especially welcome to them, on account of its greater value. This would interfere seriously with long-distance telephony, since the governmental authority in China is local for the most part. It may be strong in one province, and weak in the next, favorable to foreigners at one time or place and bitterly hostile at another.

One of the most troublesome factors in the "Eastern question" is the inability or unwillingness of the central Government to control the natives in the various parts of the Empire. China may be likened to some enormous insect, being very little affected by an accident to some of its parts, and may even be cut up into several pieces, each of which will crawl along as if nothing had occurred. But when authority is exerted, the arguments employed are very convincing. Malicious injury to the telegraph lines near Shanghai having become a serious matter, it was discouraged by the Taotai (Governor), who ordered that a head should be chopped off of *some one* in the neighborhood for each pole that was chopped down. He evidently believed in making "the penalty fit the crime." It is almost superfluous to remark that this plan was found to be effective, in spite of the fatalistic indifference to death of the Chinese, compared with Caucasian races. This should not be taken as a mere traveler's yarn; it was told to me seriously by Mr. Porter, manager of the Shanghai Telephone Exchange, who seemed to consider the punishment to be the only appropriate one under the circumstances.

The apparatus and methods employed in the Government telegraph

system are exceedingly old-fashioned. At Canton, the most important commercial city of the Empire, the office was equipped with half a dozen Morse recorders. The operators and other employees were all Chinese, including the official in charge. The only interesting feature is the code, which necessarily differs essentially from the European, since there is no Chinese alphabet, each word being represented by its own particular character. The method adopted consists in giving a special number to each word. These are arranged in columns like a table of logarithms, as shown in the accompanying sample page. The book containing this code has 49 pages devoted to the code proper and 21 pages of explanatory and other matter. Since there are 10 columns of 20 characters each, there are 200 words per page or 9800 in all. But from this total deductions should be made, because there are a good many blank spaces as may be seen in the sample page, which is a fair specimen. Like all Chinese and Japanese books, the first page is at the back, according to our ideas, and the leaves are turned from left to right. With similar perversity, the reader begins at the right hand side of the page, but strange to say, the columns are read the right way, downward. Each small square contains a Chinese character and above it the corresponding number. The latter consists of four digits, made up of the ten figures from 1 to 0, inclusive. These may be easily understood by referring to the Arabic numbers given on the margin. The characters are arranged in classes, following the order of the Chinese dictionary which has been prepared by eminent scholars duly authorized by the Government. A family resemblance will be noticed between contiguous characters—for example those in the lower half of the seventh column counting from the right, Chinese fashion.

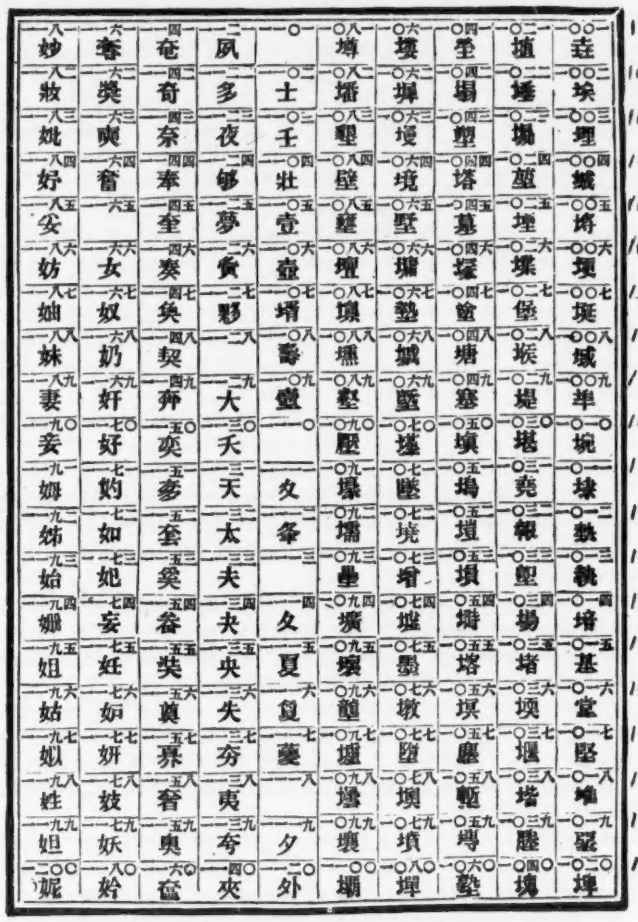


FIG I.—SAMPLE PAGE FROM CHINESE CODE BOOK.

The process of sending a Chinese telegram is as follows: The sender writes the message in Chinese characters on a blank; these are translated into the corresponding numbers by a clerk who refers to the telegraph code book already described; the numbers thus obtained are transmitted and received as such by the operators; they are then retranslated into Chinese characters by a clerk at the reciving end, and sent to the person for whom the message is intended. This appears to be a most clumsy method, but is necessitated by the peculiar nature of the Chinese language. When we study the question, it may be found that the plan has some advantages over the European alphabetic code. By means of four digits, it is possible to represent any number from 1 to 9999, or say, ten thousand different words, which is enough for all practical purposes. The average length of English words is taken as five letters, whereas the Chinese code only requires four digits. On the other hand, the signals for numerals are longer than for letters, and this would more than offset the advantage. But there is nothing to prevent us from representing the numerals by the ten shortest possible signals (combinations of dots and dashes). In this case their average length would be less than that of the letters in the European or even the American code. The Chinese plan would then give us four figures instead of five letters, each of the former being shorter than the latter on the average, so that the telegraphic representation of a word would be about 30 per cent. shorter than by our present system. Unfortunately, it is necessary to translate the words into numbers and back again, and this involves delay, labor and possibility of errors. But the actual time of transmitting the message would be less, and it is usually a fact in telegraphy that the time of the line, so to speak, is more important than the time of operators and clerks. This is the fundamental principle of automatic systems of rapid telegraphy, that it pays to have several employees punching out the messages in tape so that the number of words sent over the line in a given time may be increased. In other words it is more economical to have more employees in order to reduce the number of lines, which are very expensive to construct and maintain, when they are long, especially submarine cables. Private or other code books could be made with numbers of four, or perhaps five figures, instead of the long outlandish words that are now employed, thus avoiding the necessity for translation on the part of the telegraph company. For ordinary messages, the operators and others would soon know the numbers corresponding to the various words. After all, the Chinese telegraphy code is not so stupid as it at first seems to be. It is certainly better than it looks.

Telephones are used in most of the "open" ports of China (i. e., those in which foreign trade is allowed by treaty), but even in the largest cities their number is very limited. Shanghai having the greatest number of telephones, and being one of the most important places, has only one exchange with 4 operators, 380 subscribers and 4000 calls per day. The apparatus is of old-fashioned American make. In a previous letter I have explained how the "chit" system (sending messages by a boy) interferes with the extension and use of the telephone service in Japan. The same is true of China, and to an even greater extent, because the latter country is hopelessly conservative while the former is progressive and welcomes new things, especially applications of electricity. For the same reason, the employees of electrical establishments receive more pay in China than in Japan, probably because fewer persons turn their attention in that direction in the former country. The operators (men) in the Shanghai telephone exchange are paid 30 Mexican dollars ($15 U. S.) per month, which is about twice as much as electrical workmen get in Japan and four times as much as the wages of the operators (girls) in the Tokyo exchange.

A Large Canadian Power Project.

A project about to be undertaken at Port Arthur, Ont., is the Jenison power scheme, which, when completed, will provide that town and Fort William with one of the greatest water powers in the world. The idea is to divert the waters of the Kaministiquia River from its natural course, by means of a canal, eastwardly into a natural reservoir north of and at an elevation from the two towns. From the reservoir the water will be conducted in pipes to generators which will supply the towns with light and power. Mr. Edward S. Jenison is a hydraulic engineer, and practiced his profession in various parts of the United States, his residence being Chicago. The Kaministiquia River discharges into Thunder Bay at Fort William, and takes its rise in Dog Lake, providing an inexhaustible supply of water. About 2 miles from the river's mouth is located the Kakabeka Falls, and half a mile further up the river occurs a series of magnificent rapids. Jenison's scheme includes both falls and rapids. The project is one of colossal proportions and operations must be commenced this summer, according to the provisions made by the Ontario Government, and the entire work completed within three years. According to the by-laws voted by both towns and ratified by the legislature, these municipalities have agreed to pay $10,000 a year for thirty-three years to the power company, and in return they are to receive yearly 250,000,000 gallons of water and 750-hp of electric power, which is a 24-hour power, so that it can be used for motive power and light. It is said that the Canadian Pacific Railway will purchase power from the company for the railway grain elevators. About 2000-hp will be used in the four great storage elevators at Fort William and the one at Port Arthur will consume 1000-hp.

Some Notes on Underground Distribution of Two-phase Currents in New York City.*

By E. A. LESLIE.

The author prefaced his paper having the above title with a statement of the subway conditions in New York, which rendered it difficult to provide a reliable system of meshed conductors for alternating current, and caused his company to adopt the four-wire two-phase system of distribution.

The two circuits parallel each other, which permits of a power service and also gives at small expense a reserve circuit for lighting and single-phase motors in the case of large and important installations where an interruption of considerable duration might result in serious consequences. For this purpose a special non-arcing switch is provided, making it perfectly safe for anyone to throw over from one circuit to the other the heaviest loads the largest customer is likely to use. These switches are also frequently employed to balance the two circuits.

Other advantages of this system are comparative ease with which trouble may be located and removed, and the fact that a short circuit on one phase does not necessarily affect the other, which is not the case with a three-wire underground cable.

Serious difficulties at first were encountered at the switchboard owing to the large loads, and the regulation was unsatisfactory. It consequently became necessary to adopt a special form of board, shown diagramatically in Fig. 1, in order to scecure safety and convenience, and at the same time control the pressure of each circuit

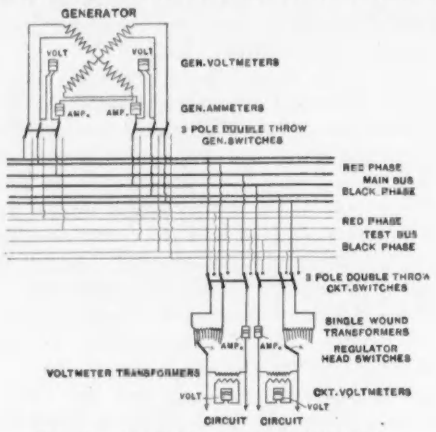


FIG. 1.—DIAGRAM OF SWITCHBOARD.

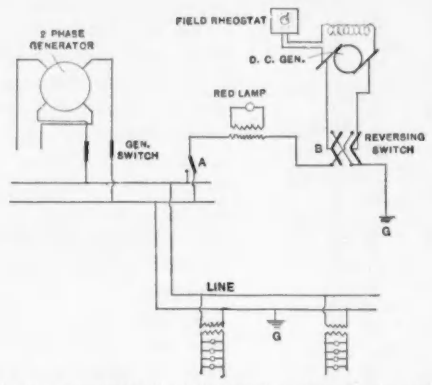


FIG. 2.—METHOD OF LOCATING FAULTS ON LINE CIRCUITS.

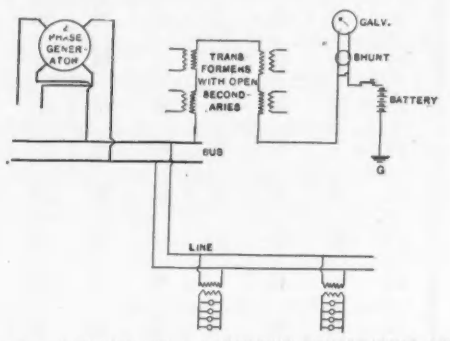


FIG. 3.—METHOD OF MEASURING RESISTANCE OF LINE CIRCUITS.

independently of the others. Records for the past ten years made it plain that, with a constant pressure maintained at the different centres of distribution, the difference of potential required at the generating ends of the various circuits at any one time would not be more than 10 per cent. of the total. A third lead was therefore brought out from the stator armatures of the generators, as shown in Fig. 1, so as to give 10 per cent. of the total voltage; that is, with the machine generating 2500 volts on each phase, there should be between leads Nos. 1 and 2, 250 volts; between Nos. 2 and 3, 2250 volts, and between Nos. 1 and 3, 2500 volts. The six leads from each machine (three on each phase) are carried through a three-pole, double-throw switch in the switchboard to the bus-bars of which there are two sets of six each, as shown. Ordinarily, but one set of bus-bars is used, as the generators are run in parallel, the other set being held for testing or the operation of a circuit singly if desired. The circuits are connected to these bus-bars by similar switches. Lead No. 3 from the switch, after passing through an ammeter, goes direct to the circuit. Leads Nos. 1 and 2 are connected to the terminals of a single-wound transformer, sometimes called an "auto-transformer" or "economy coil." This coil has eleven leads brought out, dividing the coil into ten equal parts, each part representing 1 per cent. of the total primary voltage. These eleven leads are carried to an eleven-point switch of the regulator-head type, so that any potential between 90 per cent. and full voltage of the machine (in 1-per-cent steps) may be run on the circuit. The station end of the circuit may thus be kept within one-half of 1 per cent.

Testing for Faults.—To facilitate the removal of a fault as much as possible, it was formerly the practice, whenever one of the alternating circuits became earthed, to isolate it from the other circuits by throwing it on the "test" 'bus in connection with a spare generator, and locate the trouble by means indicated in Fig. 2, shown herewith.

A single-pole, double-throw switch, *a*, is attached to the test bus and from the center of this switch, a lead is carried through the primary of a transformer which has a red lamp connected across its secondary; then through the ammeter to the diagonally opposite outside poles of a double-throw, double-pole switch, *b*; from the other outside poles a wire is carried to the ground. Current is supplied to the centre connections of this switch by a small direct-current, shunt-wound generator having a capacity of about 10 amperes at 250 volts, and by means of this reversing switch the current can be sent through the circuit in either direction.

In locating trouble, the direct-current generator, which is belted to a 5-hp motor, is started and the single-throw switch, *a*, thrown on either side of the bus. If the red lamp lights up, it indicates that the ground is on the other leg, and the switch is thrown over. The direct current is then brought up to about seven amperes and the reversing switch, *b*, is thrown about every fifteen seconds, which reverses the direction of the direct current flowing through the cable to the ground. The subway workmen then start out with a compass and go to a manhole through which the circuit in question passes. If, on laying the compass on the cable, the needle reverses every fifteen seconds, they know the ground is farther from the station; if, however, the needle is not affected every fifteen seconds, it indicates that the trouble is between the manhole opened and the station, and they then open another manhole nearer the station. In this way they are liable, without cutting the cables, to locate the trouble in a section between two manholes or handholes, or possibly in a manhole; whereas prior to the use of this device it was frequently necessary to cut in fifteen or twenty places before locating the fault.

In some cases, if the trouble is slight, it may be repaired without shutting down the circuit, as the men are provided with rubber boots and rubber gloves drawn on over buckskin gloves, and an insulated box to stand upon, and can safely and quickly make a temporary joint that will answer every purpose until such time, say, early the next morning, as the circuit can be shut down without detriment to the customers. If, however, the trouble is extensive, the circuit is shut down at once and the repair made as promptly as circumstances permit.

Unfortunately, however, the subway company objects to the circuit being run, even on an independent generator, while the fault is being located, and therefore the circuit is pulled at once and the test made in the same way, except that two compasses are used, as the direct current flows through the primaries of the transformers and tends to mislead the men if they use but one. A compass is placed on each cable, and as long as both needles are similarly affected they know that the trouble is beyond them; when, however, the needles tend to point in opposite directions, they know that they have passed the trouble and its location is then easily determined.

It is, perhaps, curious to note that when the alternating current is on the circuit the direct current apparently does not flow through the primaries of the transformers. Trouble on series arc circuits is also located in this way, except that not more than about four amperes of current is used, because otherwise the cut-out magnets tend to act and throw the regular lamp magnets in circuit, the resistance of which practically stops the flow of the current.

*Abstract of paper read at the recent convention of the National Electric Light Association.

Testing Insulation Resistance of Live Circuits.—To make reliable insulation tests while the circuits are in actual operation, the method shown in Fig. 3 was devised.

A spare generator is started and connected through its switches to the test bus. From this bus a line is carried through a high-tension switch and then through the primary coils of four transformers in series, the secondaries being left open, as shown in the diagram. This line is then carried through the galvanometer, which is provided with the usual short-circuiting key and shunt; thence it goes to a battery of 100 storage cells equipped with a reversing key, and from there to earth. The transformers used are of the ordinary 2000-volt type (which is the pressure used on the system), and are of about 2-kw capacity each, which has been

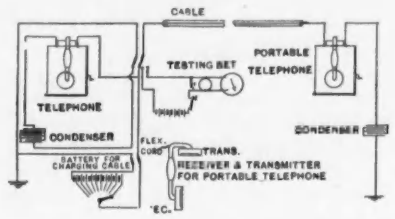


FIG. 4.—TELEPHONE CIRCUIT.

found by experience to be about the right size. The coils being in series, they offer very high inductive resistance to the passage of alternating current, but their resistance is practically nothing when measuring megohms with direct current.

In making the test the insulation resistance of the generator, test bus, leads, etc., is first ascertained. The circuit is then thrown on the test 'bus and tested in the same manner as if it were not connected to a high-tension generator, with the exception that it is not necessary to allow any time for charging or discharging the cable. This is called a "hot" test. The results are the same on testing either leg of the circuit, and the insulation resistance is generally found to be anywhere from 15 per cent. to 75 per cent. lower when tested "hot" than when the circuit is disconnected from the generator and tested in the ordinary way; that is, "cold," although the lower the insulation of the circuit, the closer the two tests appear to agree. From the records of tests it would appear that the effect of the strain of the high voltages on the insulating material surrounding conductors leads to a depreciation of the insulation of a circuit.

The Telephone in Underground Testing.—Underground circuits, particularly those employed in series arc lighting, need periodical testing, on which occasions the galvonometer is set up in the station and the foreman of the subway gang communicated with by means of a special telephone arrangement, shown in Fig. 4.

The magnetos, instead of being wound, as ordinarily, for 10,000 ohms, are wound to ring through 50,000 ohms, and a battery is placed inside of the magneto-box, the transformer and receiver being mounted on a separate L-shaped piece connected by a flexible cord to the magneto-box. The impedance of the series arc circuits, when used for telephoning, is very great, owing to the capacity of the rubber-covered, lead-sheathed cable, and, in order to talk successfully, it was found necessary to use condensers in connection with both telephones. With their use conversation can be held over the longest of the longest series arc circuits, which is twelve miles under ground and three miles overhead, and contains sixty-five lamps.

The method is very simple, as may be seen from Fig. 4. The telephone at the station end, except at time of test, is left constantly in circuit. When the subway foreman has completed his arrangements for a test, he connects one wire of his telephone to the copper of the cable and the other to the lead sheath, calls up the tester and so advises him. The foreman then disconnects his telephone, and the tester does likewise, at the same time switching in his galvanometer. The latter then makes his test and throws his telephone back into circuit. After the lapse of three minutes the foreman also reconnects his telephone and calls up to know the result of the test and get further instructions.

The other large company distributing two-phase current in New York uses a variation of the Mershon system of distribution, which is somewhat different from the system just considered, shown in Fig. 1. The generators are of the two phase type, with "star" connection, and generate a potential of twenty-five times the voltage used at the lamp. The generator leads, of which there art four, are carried through double-throw switches to the bus-bars, and from there the feeders are taken, as shown in Fig. 5. The feeders consist of three wires, two being taken from one phase—the red, for instance—and the third, of smaller size, the so-called "power wire," is taken from one of the bus-bars of the other or black-phase. Therefore, on this feeder (No. 1) the lighting is carried on the red-phase and the power taken from both; on the next feeder (No. 2) the lighting is taken from the black-phase and the power from both. In this manner the feeders are balanced between the two sets of bus-bars, so that the load is evenly distributed on the generators.

A large part of the distribution, instead of being made from house-to-house transformers, is accomplished by two large transformers placed in the vaults or basements of the larger customers, and secondary mains run out from these places to the surrounding installations, as shown on secondary mains, No. 1. The larger of these two transformers carries the lighting load, and is wound with a ratio of twenty-five to two, the primary wires being connected to the cables of one phase and the secondary to the two heavy distributing cables having a potential difference of 220 volts. The other or smaller transformer is wound with a ratio of twenty-five to four. One of its primary wires is connected to the so-called "power-wire" and the other to the center of the primary of the lighting transformer. One of its secondary wires is connected to the secondary "power wire" and the other to one of the secondary lighting wires. It will, therefore, be seen that the difference of potential between the secondary leads of this transformer is 220 volts, and that the resultant pressure between the "power wire" and the other lighting cable is 310 volts.

Where incandescent and arc lighting only are required, the two lighting cables are carried into the installations and an economy coil placed at the service to divide the pressure into two equal pressures of 110 volts each. Two sizes of coils are used, one of large and special design for theatre work and the other for ordinary installations. The leakage loss on the latter varies from .1 to .5 ampere at 200 volts, which goes on during the twenty-four hours of the day. This probably offsets the saving of leakage loss due to the use of large transformers in sub-stations instead of a greater number of small transformers as in the house-to-house system. Where arc lights only are required, the 220-volt wires are carried direct to the lamp and an economy coil is used having a ratio of 220 to 32. Where motors are required, the "power wire" is also brought in and the motor connected on the three wires as shown; although as a rule motor customers' premises are used as transformer sub-stations.

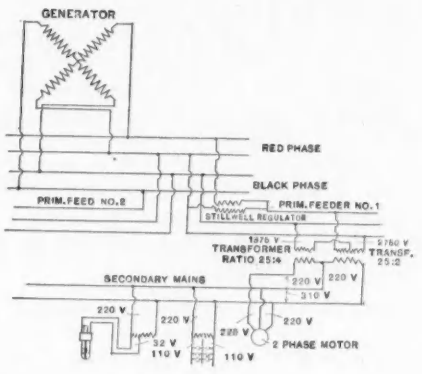


FIG. 5.—MERSHON METHOD OF DISTRIBUTION.

Both methods are capable of good work, and, so far as cost of operation is concerned, there is under the existing circumstances but little difference between the two. Mr. Leslie considers that in the matter of power service the Mershon method has a distinct advantage in operating elevator motors of large size, because the primary current is taken, one-half from the lighting circuits and the remainder from the "power wire," whereas in the other method it is taken entirely from the lighting circuits, and the heavy inrush currents at the time the motors start vary the pressure and sometimes produce disagreeable effects upon the lighting, particularly in localities where the copper is scant.

Transformers—Iron Loss—Its Increase and Remedy.*

In opening his paper on the above subject, Mr. G. Wilbur Hubley stated that no other question has more commercial significance in the operation of a transformer system from a central station standpoint than the constant iron losses of transformers in service. It has been found in practice that transformers with initially low iron losses show a most decided increase, in most cases as high as 100 per cent. and in some cases as high as 300 or 400 per cent. within very short periods of service under normal conditions. A table of data from actual tests was given, showing increases, the smallest being 20.8 per cent. and the largest 108.4 per cent. during an interval of about two years.

Mr. Hubley gave the accompanying table, which forms part of the transformer specifications issued by his company:

REQUIREMENTS FOR TRANSFORMERS.

Capacity.	Iron Loss.		Regulation Per cent.	Capacity.	Iron Loss.		Regulation Per cent.	Capacity.	Iron Loss.		Regulation Per cent.
	Watts.	Per cent.			Watts.	Per cent.			Watts.	Per cent.	
500	35.	7.00	3.00	3750	90.	2.40	2.50	15000	210.	1.40	2.00
600	30.	6.00	3.00	4000	90.	2.25	2.50	18750	225.	1.20	2.00
1000	45.	4.50	3.00	5000	110.	2.20	2.25	20000	240.	1.20	2.00
1250	45.	3.60	3.00	6000	120.	2.00	2.25	25000	275.	1.10	2.00
1500	51.	3.40	3.00	6250	125.	2.00	2.00	30000	300.	1.00	2.00
2000	60.	3.00	3.00	7500	150.	2.00	2.00	37500	375	1.00	2.00
2500	65.	2.60	2.50	10000	175.	1.75	2.00	50000	500.	1.00	2.00
3000	75.	2.50	2.50	12500	200.	1.60	2.00				

The specifications also state that insulation tests are to be made by a series of make-and-break contacts and one prolonged contact, the voltage to be 6000 between the primary and secondary coils, 6000 between the primary coil and core and 1000 between the secondary coil and core. A temperature test is made by means of thermometers placed in mercury cups in the core of the transformers, and the increase above the surrounding atmosphere on full load test of eight hours' duration must not exceed 60 degrees C. The iron loss must not exceed 10 per cent. increase within a period of two years' service. The transformers must be guaranteed to stand an overload above the rated capacity of 25 per cent. for a duration of two hours with the temperature increase not to exceed 60 degrees C. above the surrounding atmosphere. The transformers must be guaranteed for two years' service against any burn out from any cause (including lightning), provided these occur under normal conditions of service. In case of failures of transformers furnished under the above specifications, all expenses of rejection are borne by the manufacturer.

Mr. Hubley said that he has obtained gratifying results in the treatment of transformers which have shown an abnormal iron loss, which consists in annealing the iron. In all cases this has reduced the losses to their initial (or even better) record, and in no manner has affected other requisite qualifications of the transformer. The cost of the treatment as practiced is very low, not exceeding 90 cents per kilowatt, including preparation, annealing, assembling and testing, and this should be very considerably decreased, he stated. A liberal estimate will vary between 22 cents per kilowatt for 25-kw size, to $2.20 per kilowatt for ½-kw size. The accompanying table gives the saving that may be made by applying the process of treatment referred to.

SAVING FROM ANNEALING TRANSFORMERS.

Capacity Watts.	Loss per Year. kw-hours.		Saving per year kw-hours.	Saving per year at 2c. per kw-hour.	Estimate Complete Cost Treatment.	Interest per year per cent.
	Before Treatment.	After Treatment.				
500	560 64	367 92	192.7	$3.85	1.10	350.
1,000	770.88	516.84	254.0	5.08	1.85	275.
2,000	1314.02	1024.92	281.1	5.78	2.60	222.
3,000	1217.64	849.72	367.9	7.34	3.60	204.
7,500	1462.90	1182.60	280.3	5.60	4.50	125.
10,000	2102.40	1401.60	700.8	14.00	5 00	280.
25,000	4642 80	1813.30	2829.5	56.59	5 50	1029.

In reply to a question Mr. Hubley stated that the process is simply that of annealing the iron, the transformer being taken apart, the iron annealed in the ordinary way and the parts then reassembled. The temperature of annealing corresponds to that of cherry red.

*Abstract of paper read at the recent National Electric Light Convention.

CURRENT NEWS AND NOTES.

CHEAP ARCS.—The Newark, N .Y., Electric Light, Heat and Power Company reports having taken a contract for 58 arcs of 2000-cp at $19.95 per lamp per year on a five years' contract. Such prices strike one as sheer foolishness.

CHEAPNESS OF EXPENSIVE VOLTMETERS.—It is well known that if an electromagnetic voltmeter is used in a central station a small current will be flowing through it all the time, while this is not the case with an electrostatic instrument. The London *Electrician* states that when this amount of wasted energy is capitalized it will more than make up the extra cost of the electrostatic instrument.

BRAKES APPLIED BY PASSENGERS.—In the new automobile cabs in Paris there is an arrangement in the interior of the vehicle which enables the passengers to check the speed or even bring the vehicle to a standstill, independently of the action of the motorman. It seems that this is due to the reckless speeds with which these vehicles are being driven. There is another novelty in the form of a register which is placed at each cab stand, in which the patrons may enter any remarks or suggestions, the object of the company being to obtain their opinions.

THE JAMAICA ELECTRIC TRAMWAY COMPLETED.—After a sojourn of nearly two years in the tropics, Mr. F. P. Brothers, who has been manager of construction of the West India Electric Tramway Company of Kingston, Jamaica; Mr. Norman S. Rankin, secretary, and Mr. Shirley Davidson, civil engineer, have returned home to Montreal. The last railways of the Jamaica electric tramway were laid on the 23d of May last, thus completing a magnificent line some thirty miles in length. Unusual attention and care was given to the permanency of construction. The rails are bolted into steel ties, and they in turn are set in concrete. It has been found that wooden ties, such are used in the more northern countries, will not last, owing to the climatic conditions and the insects. Naturally construction work of this kind makes a very fine roadbed. After the tramway was in a state where its operation was possible, both Mr. Davidson and Mr. Rankin turned in and acted as motormen, in order to give the Jamaicans the necessary instruction. They report that at the present time the road is operating a considerable number of cars with good success and the financial position of the road seems secure and will make good dividends for shareholders. The employees of the road are to a very large extent black or brown men, as they call the half-breeds. These men employed on the construction work are paid 42½ cents per day, which is considered very good wages for this class of labor in Jamaica. A black man has the same rights as a white man in Jamaica, and he sees that he gets them, too.

DENVER'S MUNICIPAL ELECTRIC LIGHT PLANT.—Plans for the new electric light plant to be owned and operated by the city of Denver have been nearly completed, by City Electrician Sayer, who declares that the plant will be among the best and most complete in the United States. Its capacity will be 2000 arc lamps, with 20 per cent. of the units in reserve. The engine will be a triple-expansion Willans centre-valve, direct connected. The dynamos will each have a capacity of 125 arc lamps. The boilers will be of the water tube type, working at a pressure of 180 pounds. The floor of the boiler room will be 20 feet below the surface of the ground and the coal will be taken directly from the cars and thrown into the bin, which will have a capacity of 50,000 tons. The coal will fall by gravity from the bin into hoppers that feed mechanical stokers, the only handling being when it is thrown from the cars into the bin. The boilers will be provided with Green economizers, and the feed pumps and machine shop tools will be driven by electric motors. The engines will run non-condensing, and the exhaust steam may be distributed throughout the city for heating purposes. Mr. Sayer has embodied in his plan a scheme to meet the practical demand for electric power for automobiles. It is proposed to establish substations at different points in the city so located and constructed as to be capable of supplying the necessary current for charging the batteries of electric vehicles. The estimated cost of the new plant is about $169,000. It is expected that the plant will be in operation by January next.

ELECTRICAL APPARATUS IN HUNGARY.—Mr. Hugo Donzelmann, United States Consul at Prague, Austro-Hungary, says that there is a great demand for electrical supplies in that district and that agents might profitably be sent from this country. He refers also to the large number of electric street car lines projected. German goods and agencies seem to be under a practical boycott.

ELECTRICAL CONSOLIDATION IN GERMANY.—The interests of the allied concerns, the Bank für Electrische Industrie, and the Electricitats-Gesellschaft Felix Singer & Co., both of Berlin, have been consolidated with those of the Helios Electricitats-Actien-Gesellschaft and its financial branch, the Gesellschaft für Electricitats-Anlagen, both of Cologne. The capital of the Helios Company has been raised from 10,000,000 to 16,000,000 marks, that of the financial branch remaining at the latter amount. The Helios Company, which has heretofore been principally engaged in the manufacture of electric light machinery, will now enter the electric railway field, both as manufacturer and in construction work. Mr. Felix Singer, who has built a large number of railway and lighting plants, using Walker apparatus, will not be connected with the consolidated company.

FIELD COIL HOLDER AND NEW BRUSH HOLDER.—A patent was issued on June 6 to Mr. Robert Lundell, New York, for a field coil holder, consisting of a wedge-shaped polar extension between the coil and its core, provided with a groove or catch at its outer end which will engage in an equivalent catch upon the pole piece. The wedge-shaped polar extension is of high magnetic reluctance and extends along the sides of the field cores for the purpose of holding the coil in position and for reducing the magnetic flux at the pole corners. The brush holder consists of a supporting shank surrounded by a square insulated sleeve, and clamped in a holder which permits the shank to be adjusted in a plane parallel with the commutation on the commutators. The clamp consists of an eye-bolt and an insulating sleeve adapted to be held by the eye-bolt between two stationary ribs.

AUTOMOBILES IN ENGLAND.—An automobile show will be opened on June 17 at Richmond, London, by Prince Edward of Saxe-Weimar. There will be tests of hill-climbing, and races between fast horses and automobiles. It is stated that the Dukes of Marlborough and Manchester are endeavoring to start the fashion of using automobiles. An American company is establishing works at Coventry for the purpose of building motor cars invented by a son of Hiram Maxim. The capital is said to be $500,000, and the company, it is added, means to rush the construction of automobiles, which has been almost neglected in England, and it is believed that with the great superiority of the American cars, coupled with labor-saving machinery, the company will get a clear six months' start in the market over its English rivals. The new departure has already created anxiety, and some of the biggest cycle firms are contemplating similar ventures.

MEASURING FREQUENCY.—In an article in the April number of the *Physical Review*, Prof. Carl Kinsley described a simple method for measuring the frequency of alternating currents. This consists of using a strip of iron set in vibration by an electromagnet energized by the alternating current. The length of the strip remains constant, the necessary adjustment to the periodicity being made by adding a non-magnetic rider to the bar. The periodicity is calculated from the length, width, thickness and cross section of the bar and the density of its material, and the mass of the rider in grams and its position on the bar. The equation is as follows:

$$f^2 = A\frac{mr^2}{hd^3} + B\frac{h}{d^2}$$

where m is the mass of the rider, r its distance from the point where the strip is clamped, h the width of the strip, d the thickness and l the length. The value of A is 1.17×10^{10} and of B, 2.13×10^{10}. The rider is adjusted on the bar until the position of resonance is attained. It has been found that by this means the frequency can be determined within ¼ of one per cent.

CANADIAN ELECTRICAL ASSOCIATION.—The annual convention of the Canadian Electrical Association will be held at the New Royal Hotel, Hamilton, Ont., June 28, 29 and 30. The social features will include a trip on Wednesday to Burlington Beach, and an excursion on the lake, returning by the Hamilton Radial Railway, with a visit en route to the power stations of the Hamilton Street Railway Company and the Hamilton Radial Railway Company; a trip on Thursday to Grimsby, over the Hamilton, Grimsby & Beansville Electric Railway, and on return a visit to the Hamilton Electric Light & Power Company's power station, and on Friday a visit of inspection to the Cataract Power Company's works at DeCew Falls. The annual Association banquet will take place on the last evening of the convention. Following is a list of papers that will be read: "Meter Rates," by A. A. Dion; "Cost of Steam, Electric and Water Power," by C. B. Hunt; "Underwriters' Inspection," by W. J. Plewes; "The Enclosed Arc Lamp," by W. A. Turbayne; "The Incandescent Lamp for Central Stations," by E. E. Cary; "Central Station Accounting," by P. H. Parke; "Transformer Economy," by F. E. Leonard, Jr. An oral description of the Cataract high-tension distribution will be given by Mr. H. R. Leyden.

LIABILITIES OF TELEGRAPH COMPANIES.—In a recent opinion of the Louisiana Court of Appeals that tribunal has this to say regarding the correct transmission of telegrams: Correctness of transmission of a message is a feature of telegraphic convenience and usefulness second only to rapidity of transmission, and to insure this correct transmission the telegraph company must employ all available ordinary means necessary to its accomplishment. If repeating a message is proper and necessary to insure accuracy, and if accurate transmission is an essential part of the contract, then there is no good reason why the telegraph company should not repeat the message under its original obligation without additional charge to the sender, at least if the message is so worded as to convey the intimation, if not positive information, that it relates to a business transaction, from which, by an erroneous transmission or delay either in transmission or delivery some pecuniary loss may possibly result. Where a message is in cipher, or in language intended to be unintelligible to the telegraph company and its operators, and an error has been made in its transmission, consequential damages are to be excluded from consideration, and the recovery limited to the sum paid for the message as stipulated in the contract; but where the face of the message shows that a business transaction is contemplated and that negligence in its transmission may reasonably be attended with pecuniary loss, although the message does not disclose the full meaning of the sender, damages are not restricted to the sum paid for the message, if there should be a negligent alteration of the message in the course of its transmission.

SUBSTITUTE FOR PLATINUM TERMINALS.—On June 6 a patent was granted to MM. Guillaume and Dumas for an alloy of iron and nickel. The name of the former will be recognized as the discoverer of the fact that nickel at a temperature of about 350 degrees C. possesses an extremely high thermo-electric power. The patentees have discovered that alloys of nickel and steel expand and contract under variations of temperature in accordance with a law which is peculiar to such alloys, and differs generally from the laws governing the expansion of nickel and iron separately. By varying the proportion of iron and nickel, an alloy is obtained whose coefficient of expansion varies within considerable limits according to a law expressed by a simple ratio. For example, with a proportion of nickel of 22 to 24 per cent. the coefficient closely approximates that of brass, and beyond 24 per cent. the coefficient of expansion increases progressively until when the proportion of nickel reaches about 37 per cent. it is practically nil. Beyond this the coefficient again increases progressively, equaling that of platinum when it reaches 45 per cent. Consequently to obtain an alloy having the same coefficient of expansion as glass, which is slightly less than that of platinum, a proportion of nickel of about 37 per cent. may be used to obtain the desired result. An alloy having 29 per cent. or one having 44 per cent. of nickel, possesses also the same or practically the same coefficient of expansion as glass. The alloy may be produced in crucibles or Martin furnaces or by any of the ordinary processes employed in steel manufacture; and it may contain besides nickel and iron, a varying quantity of metals or metalloids, sometimes present in the latter, such as, for example, carbon, silicon, manganese, or, as impurities, traces of sulphur or phosphorus. The addition of small quantities of chromium and tungsten does not noticeably affect the expansion or contraction of the alloy. The patentees state that their invention is applicable for the production of objects or articles wherever glass and metal are combined or connected, such as in the manufacture of incandescent lamps, spectacle frames, mirrors, optical instruments, etc.

AMERICAN EXPORTS.—European manufacturers are so slow in filling orders that many contracts from various countries are being filled by American companies, who are much more prompt in executing orders for electrical apparatus. It seems from a recent statement that orders are now coming to this country from Japan for this reason. We recently learned from a native of Switzerland that it is difficult to get goods promised in less than a year's time from European manufacturers; he gave this as the chief reason why so many orders were being sent to this country.

HORSELESS CARRIAGES FOR THE ARMY.—Gen. Greely, Chief Signal Officer of the U. S. Army, has invited proposals for furnishing the army with three electric carriages, with which some interesting experiments will be conducted near Washington, Gen. Greely's idea is that these carriages can be used for paying out a telegraph or telephone wire and promptly connecting two points between which communication is desired. This experiment is one of a number that will be made to determine to what extent horseless carriages may be used in the signal service.

A NEW BRANLY COHERER.—In a recent paper before the French Academic des Sciences, M. Branly described some experiments with new types of so-called coherers. One consisted of a vertical column of disks of highly-polished iron surmounted by a weight to insure the best contact. Another consisted of a number of metallic spheres superposed, thus offering a small surface of contact, and therefore much greater sensibility than the column of disks, which surmise was verified by experiments. To compare the sensibility of the column of spheres with that of tubes of filings, an experiment was made with six hard steel balls of one-half-inch diameter. The sensibility was found to be almost as great as when a tube with gold alloy filings was used. With this type of coherer, it is necessary to fix, according to the conditions of use, the diameter, the number of spheres, the degree of polish of the surface, the pressure, the degree of vacuum and the e. m. f. of the cell in series.

ELECTRICAL THAWING DEVICE.—Mr. N. Grayburn, assistant superintendent and electrical engineer of the Montreal Street Railway, has perfected and patented an electrical device for thawing purposes, intended more particularly for mining use in the Northwest. The Hon. Mr. Sifton, Minister of the Interior, sent two competent men to Montreal to examine the new invention, who have reported that it is a great success. The apparatus at the mines consists merely of two metal plates attached to the ends of two wires conducting the electric current. A large proportion of all the electricity generated is converted into heat by the resistance of the earth to the current. This heat is under control, and can be applied to the ground to be removed, without loss. From four to eight feet of ground can be thawed between the plates, and it is claimed that sinking can be done at one foot per hour. This means that bedrock can be reached in one day. A company has been formed in London, England, to develop the new process, having a capital of $5,000,000. It is the intention of the company to acquire properties in the Yukon countries and apply the invention upon a large scale. The new invention is also designed to be employed in cities for the thawing out of water pipes. Mr. Grayburn will shortly leave Montreal for Glasgow, G. B., where he has obtained the position of electrical superintendent of that city's tramways, which are to be converted into the trolley system by the Corporation of Glasgow. Mr. Grayburn has filled several important electrical positions in the United States.

EXPORTS OF ELECTRICAL MATERIAL.—The following exports of electrical material were made from the port of New York during the week ending June 6: Antwerp—8 packages electrical machinery, $630. 54 cases electrical material, $3144; Argentine Republic—11 packages electrical material, $217. 1 case electrical machinery, $80; Bremen—1 case electros, $150; British Possessions in Africa—92 cases electrical material, $6808; Brazil—44 cases electrical material, $2437; British East Indies—15 cases electrical material, $374; Berlin—5 packages electrical material, $3746; British West Indies—1 case electrotypes, $15. 20 packages electrical material, $1440; British Australia—8 cases electrical material, $358; Brussels—7 cases electrical material, $226; Cuba—18 cases electrical material, $663; Central America—9 cases electrical material, $220; Constantinople—1 case electrical material, $6; Chili—1 case electrical material, $154; Ecuador—5 cases electrical material, $74; Glasgow—36 packages electrical material, $735; Havre—14 cases electrical material, $1750; Japan—3 cases electrical material, $113; London—61 packages electrical material, $3832. 27 cases electrical machinery, $2149; Liverpool—27 packages electrical material, $940; Mexico—13 cases electrical material, $329; Milan—3 cases electrical material, $87; Nice—14 cases electrical material, $116; New Zealand—6 cases electrical material, $111; Porto Rico—1 package electrical material, $35; Rotterdam—7 cases electrical material, $247; Southampton—4 cases electrical material, $90. 12 cases electrical machinery, $635; Siam—14 cases electrical material, $462; U. S. of Colombia—39 packages electrical material, $929; Venezuela—2 cases electrical material, $47; Zurich—1 case electrical material, $76.

EXPORTS OF ELECTRICAL MATERIAL FROM NEW YORK.—The following exports of electrical material, machinery, etc., are from the port of New York for the week ending May 23: Antwerp, 38 cases electrical material $2108; Aden, 6 cases electrical material $116; Argentine Republic, 28 cases electrical material $1979, 14 cases electrical machinery $773; British possessions in Africa, 13 cases electrical material $397; British East Indies, 22 cases electrical material $2553; British Australia, 1 case electrical material $12; Berlin, 4 packages electrical material $2650; British West Indies, 4 cases electrical material $151; Brazil, 3 cases electrical machinery $142, 69 cases electrical material $2313; Bremen, 3 packages electrical material $135; Cuba, 50 cases electrical material $1406, 13 cases electrodes $7050; China, 12 cases electrical machinery $613, 29 cases electrical machinery $787; Ecuador, 1 case electrical material $83; Glasgow, 4 cases electrical material $330; Hong Kong, 21 cases electrical material $753, 12 cases electrical machinery $830; Havre, 27 cases electrical material $2323, 4 cases electrical machinery $50; Hayti, 15 packages electrical material $10; Hamburg, 15 packages electrical material $1267; Japan, 55 cases electrical material $1600, 104 cases electrical material $8022; London, 286 packages electrical material $9881, 3 cases electric motors $500; Liverpool, 1 electric crane $3500; Moscow, 3 cases electrical material $192; Mexico, 429 packages electrical material $11,620; Nice, 64 cases electrical material $12,970; Newcastle, 1 case electrical machinery $80; Peru, 10 packages electrical material $293; Rotterdam, 2 cases electrical material $100; Southampton, 6 cases electrical machinery $196; Siam, 26 cases electrical material, $1335; U. S. of Colombia, 29 cases electrical material $750; Venezuela, 8 packages electrical material $265; Vladivostock, 7 packages electric motors $800.

A NEW EDISON LAMP.—A patent was granted June 6 to Thomas A. Edison for an improved incandescent lamp filament of high resistance for use on high-tension circuits. The filament consists of a highly refractory, porous, non-conducting material of a rare earth oxide; incorporated in the body thereof are isolated particles of carbon, between which are spark gaps whereby high-tension currents, either alternating, continuous or intermittent, will be conducted from particle to particle of the carbon and thus raise the filament to incandescence. As the filament is of a highly refractory non-conducting porous material, the interior will be subjected to the effect of the vacuum in the globe, which will assist in the conduction of the current through the carbon particles. The highly refractory material consists of an oxide or oxides of the rare earths, such as oxide of zirconium or thorium. In order to provide an exterior surface for the filament which will radiate light, it is momentarily dipped in the salt of the oxide, such as the acetate, which will leave no carbon upon carbonization, and provide a white radiating surface. In making the filament, a compound such as a solution of sugar, asphalt, or a tartrate of the oxide itself, is mixed with the refractory material, a residue of carbon thus resulting upon carbonization. The mixture is forced by heavy pressure through a small opening and guided to form a filament of the desired cross section, which is then bent into proper shape, carefully dried and carbonized. Owing to its high resistance, a voltage of several hundred is necessary in operation. The filament may also be formed by soaking threads of cotton in the salt of the oxide, such as acetate, and carbonized to form a deposit of the oxide thereon; then resoaked and reheated successively until the desired quantity of oxide has been deposited, after which the filament may be soaked in the carbonizing substance; after being dried, it is dipped in a solution of a salt of the oxide of a rare earth, such as zirconia or thorium, preferably an acetate of such oxide, to form the white radiating coating desired.

AUTOMOBILES IN THE PARIS FIRE DEPARTMENT.—An autocar has been constructed in Paris for the fire brigade to carry the escape ladders, ropes and other appliances, and eleven passengers. The vehicle is provided with an electric motor, the accumulators being placed underneath the body of the carriage, in which stands the fire escape. When put through its trials, the new car, fully equipped, and conveying the engineer, the brigade officer, his orderly, and eight firemen, behaved very well, keeping up a speed of fifteen miles an hour, and negotiating inclines, which in Paris are considerably steeper than in New York, without difficulty. It was also ascertained that the vehicle could be brought to a dead stop in a few yards. The new motor-car will be put into use at the headquarters of the Paris Fire Brigade. It is expected that all the stations of the city will be provided with similar vehicles in due course.

LETTERS TO THE EDITORS.

New Method of Shunt Excitation.

To the Editors of Electrical World and Engineer:

Sirs—I have read with interest the editorial appearing in your issue of 27th ult. regarding Prof. Sengel's "New Method of Shunt Excitation." The advantage to be gained by applying this method of excitation to a shunt motor, however, is not so apparent.

Supposing, when starting a motor, that the commutator segment connected to the collector ring is 180 degrees (assuming a bipolar motor) from the brush to which is connected the other terminal shunt winding, the fields would, of course, be subjected to a momentary double voltage and the motor would start with a heavy torque. At the end of a half revolution, however, the field becomes short-circuited, and the armature will stop and tend to revolve in the opposite direction in a field due to the armature reaction only. It would seem, therefore, that this ingenious method of field excitation is applicable only to generators, and of value in machines of higher voltages only.

W. CLARK.

LYNN, MASS.

[The editorial referred to took for granted the use of a starting resistance in the armature circuit, as universally employed in starting direct-current motors on constant-potential lines. In starting almost the entire drop of potential would be in the starting rheostat, and the collector ring would be practically at the potential of, say, the negative line. The field, of course, would be connected between the collector ring and the positive line, and would at starting have the full voltage between the mains. As the machine rises in speed and the starting rheostat is cut out, the voltage is transferred, so to speak, from the starting rheostat into the armature, and the mean potential at the collector ring would rise to a value midway between the potential of the positive and negative lines as the machine arrives at full speed. Thus the machine field winding would have at standstill the full voltage across the line, giving it double the normal exciting current at the very time when extra field strength is most needed. With representative modern machines with considerable air gap this might increase the field flux 33⅓ per cent., which would diminish the armature current necessary to overcome a given torque just 25 per cent. In other words, the starting current—so serious in motors which work on elevator, crane and similar loads—would be diminished 25 per cent. The same result is obtained in a motor especially designed for such loads by a well-known manufacturer in this country, by winding the entire starting rheostat upon the field magnets, making it temporarily act as a series field.—Editors.]

Boiler and Furnace Efficiency.

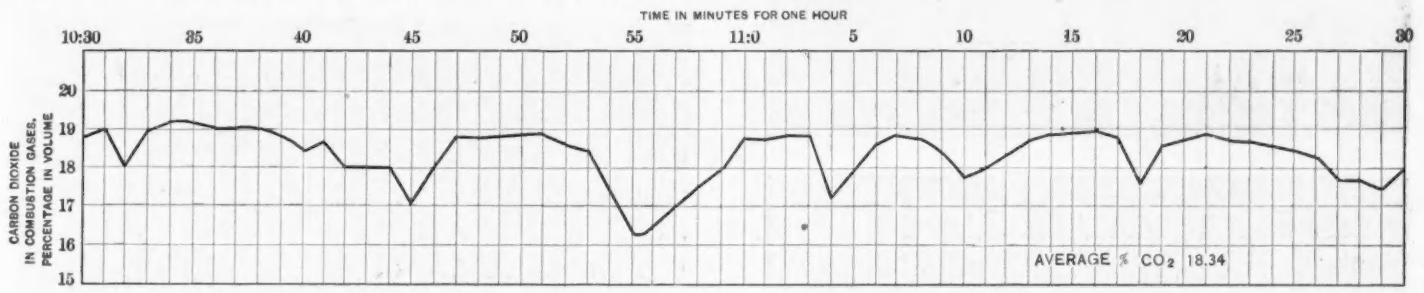
To the Editors of Electrical World and Engineer:

Sirs—Your reference on page 655 of the May 20 issue to Mr. R. S. Hale's recent paper on "Boiler and Furnace Efficiency" has attracted the writer's attention, and some remarks in this connection may be of interest.

It is no doubt true that a full knowledge of the constituents of the combustion gases affords a basis for ascertaining the efficiency of the steam generator fully as reliable as an evaporative trial alone, and certainly affords a valuable amount of information concerning the performance of the furnace, which is otherwise not available. At best the trial of a steam generating apparatus—boiler and furnace being meant—is guesswork, unless the relative constituents of the gases are known, both as a means of accounting for the heat generated and as affording a guide in managing the furnace.

The method now employed for gas determinations is not comprehensive enough, as the occasional analysis is not likely to afford a reliable average for the purpose of calculating the heat balance, and certainly not frequent enough to afford a thoroughly satisfactory guide for managing the furnace.

The writer would suggest as a means of obtaining a perfect average sample of the gas for the purpose of the heat balance, that a suitable tank be used for gathering the sample, so arranged that by a uniform discharge of water or by other suitable means, gas will be continuously drawn in, this device to be started at the moment of beginning the trial and stopped at the moment of ending. Thus one average sample is available for analysis, which not only simplifies the problem but affords the most reliable information. Thus during the trial the troublesome labor of gas analysis is dispensed with unless the engineer desires to make analyses as a check on the possible formation of carbon monoxide. It is assumed that a continual determination of the carbon dioxide will be made as a guide in managing the furnace.



CURVE PLOTTED FROM DETERMINATIONS OF CARBON DIOXIDE.

In such furnaces as the Hawley and with stokers having a uniform feed, a uniform condition of combustion is possible, and with them the determination of carbon dioxide is a sufficient guide for the prevention of carbon monoxide and the reduction of any excess of air supply, but with irregular working furnaces, such, for example, as the hand-fired, the prevention of carbon monoxide is a more difficult, although not serious matter, when effort is made to keep down the excess of air.

The furnace or the management of it are the controlling factors as affecting the efficiency of the steam generator, and of all the losses those to the chimney are the greatest, and of these the loss in the dry gases is the largest. This loss is carried in air which passes through the furnace and not used in the combustion process. Thus, to illustrate the possible efficiency with an ideal state of combustion, it is assumed in burning a good quality of coal, with practically perfect combustion without excess of air, the losses as affecting the combustion would be in dry gases leaving at 350 degrees Fahr., 5 per cent.; loss from moisture in air, burning hydrogen, radiation, etc., 6 per cent.—a total loss of 11 per cent., leaving 89 per cent. for useful work. While it may not be considered practical to speculate regarding such an ideal accomplishment in the way of combustion, yet the matter is entitled to consideration, as there is approximately 10 per cent. between this and the present attainments.

As illustrating what may be accomplished in an experimental way, the accompanying curve plotted from the determinations of carbon dioxide taken at one-minute intervals, will be of interest. According to Dr. Bunte, with the maximum volume of carbon dioxide, all of the carbon being used and the chemically required amount of air being supplied, the percentage in volume would be

18.9. Thus it will be observed that the theoretical condition was attained several times, and might have been maintained in a uniform working condition. This would have been the case had it been a self-feeding furnace, but being a hand-fed, the irregularity was due to the fireman. It should be stated, however, that he practiced only about a half hour before the experiment to ascertain the rate of feed of the coal.

As uniform conditions are necessary for high efficiency of combustion, it has occurred to the writer that in electric plants especially, it would be well if boiler pressures were carried as much above that required by the engines as practicable, and brought down to the pressure suitable for the engines by means of reducing valves. That not only would allow of more uniform working of the furnaces as loads changed, by having a reserve, but would also be beneficial in reducing condensing, owing to the superheating effect caused by the reduction in pressure.

CHICAGO, ILL. A. BEMENT.

The Nature of Lightning Discharges.

To the Editors of Electrical World and Engineer:

Sirs—Concerning the peculiar vortical and vibratory effects noticed by Dr. W. J. Morton in certain lightning flashes, and forming the subject of an article in your issue of April 15, I am inclined

WHIRLING MOTION OF CLOUD MATTER.

to think that the photographs must be supplemented by further evidence of motion. A flash occurs between cloud and cloud or cloud and earth and as Dr. Lodge aptly puts it, is the discharge of a large air condenser. But the line of strain is not necessarily a fixed line even for one second. Not only are the coatings of the condenser in motion but the intervening dielectric is also in motion often at a rate of 15 metres or more per second. A noteworthy feature of thunder-storms is a rapid change in both direction and velocity of air strata differing but little in elevation. Gyratory effects are pronounced in this type of disturbance and I inclose a photograph showing whirling motion of cloud matter and which might be used in support of the view that a real rotary motion existed in the discharge.

The line of luminous gas when photographed in one plane and on a plate exposed for an appreciable time ought to show curious twistings. Such departures from a clean-out straight path are accentuated on the photographic plate by further discharges along the line of the first break-down, which, however, has moved in the interim.

The photograph referred to by Dr. Morton shows to me, more of the ribbon or tape appearance than a vortex. It looks as if the flash had been traveling edgewise with referenec to the plane of the plate. I inclose for inspection and comparison photographs made by Dr. Weber with a moving camera (from "Protection from Light-

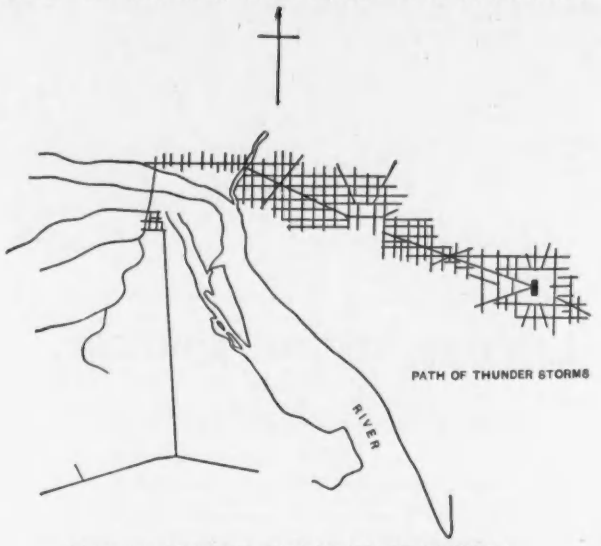
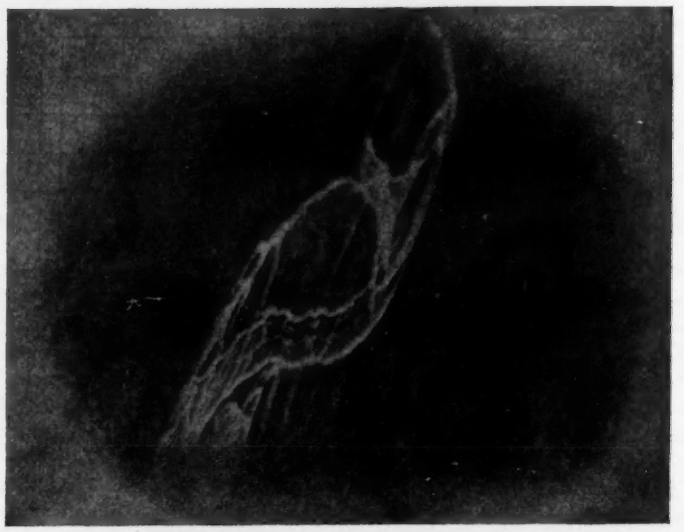
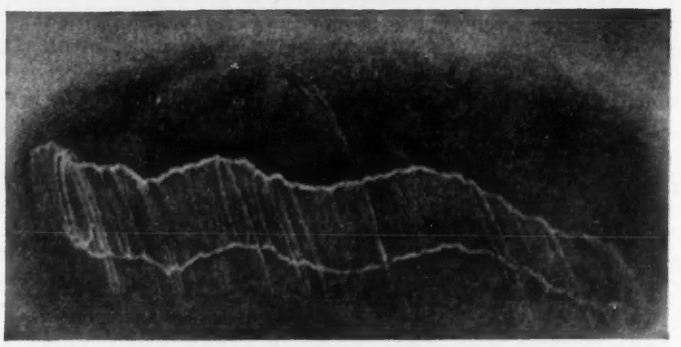


DIAGRAM SHOWING DISPOSITION OF CAMERAS.

ning," published by the United States Weather Bureau, 1895), and you will see that a similar effect is obtained. In brief then, the spiral rotation is apparent rather than real, and is produced either by motion of the camera or an appreciable shift in the line of discharge, all aided by an obliquity of direction with reference to the plane of the plate.

This discussion naturally suggests the question, "Why not photograph a flash from several points of view simultaneously in order





LIGHTING PHOTOGRAPHED IN MOVING CAMERA.

to determine its true direction and character in space?" What follows relates to just such an experiment.

In the American *Journal of Photography* for November, 1896, I gave a description of an experiment where three cameras were aligned upon the apex of the Washington Monument. The edifice is 555 feet high, and makes a prominent feature in the landscape. The diagram shows the disposition of our cameras. The observer

at the capitol was 7500 feet east; the observer at Arlington, across the Potomac River, 16,500 feet away to the southwest; and the observer at the Weather Bureau, 7250 feet distant to the northwest. We thus had the monument under photographic surveillance from all points of the compass. Whenever, between the hours of 7:30 and 10:30 p. m., a thunder-storm was expected, the observers were at their posts, exposed their plates and waited patiently.

As we have said above, there were very few flashes that summer in close proximity to the monument, and the few that did occur were feeble in character. Our photographs showed, however, that to the southeast over the water and lowlands, beyond the district line and on into Maryland, the majority of the flashes occurred. In fact, the path of the thunder squalls was marked out by the lines of lightning discharge. Some flashes, about half-mile southeast of the monument, came within our field of work, and we obtained simultaneous photographs of them, although a little distorted. Change in direction was clearly shown, and with a piece of stiffly waxed string we subsequently made a rough model of one of the flashes, showing how it started to come to earth in one direction and then changed. The exact location of the flash was determined by the interesting lines and each change of direction by the appropriate photograph in that plane.

By the close of the thunder-storm season it became apparent that we were working under abnormal conditions. There were many people in Washington who thought they saw flashes close to the monument, but as we had photographs of the flashes identifying them by the time, we knew that in reality the flashes, while in line with the monument, were far to the southeast.

It has always seemed to me that before we can offer adequate protection against lightning, we must measure the flashes and know something of their dimensions and energy. It is only wise to attempt to harness when you know how strong the object to be harnessed is. We can measure directly the work done by lightning infusing metals or breaking wood and masonry, or, as we have suggested, by photographically determining the dimensions of the flash, and working out, as Dr. Lodge has done, the electrical energy of a flash of such dimensions.

I may mention that on comparing the width of one of the flashes with an object of known dimension close by, we made the width of the lightning streak certainly not less than ten feet. But as the intensity of the light will determine largely the impression on the plate, it will not do to say that the flash was ten feet wide.

ALEXANDER MCADIE.

SAN FRANCISCO, CAL.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

LIGHTS AND LIGHTING.

Enclosed Arcs.—A brief reply to criticism of her recent paper. She describes that she was not dealing with the best way of prolonging the life of the carbons in the enclosed arcs or of preventing a deposit from the vapors; the perfect exclusion of the air was intentional. Editorially the opinion is expressed that it is not necessary that a slight admission of air should be allowed for preventing the deposit on the globe.—Hertha Ayrton. Lond. *Elec.*, May 26.

REFERENCES.

Alternating Current Arc.—Corrections by the authors, in the publication of the discussion of their recent paper.—Duddell and Marchant. Lond. *Elec.*, May 26.

Two and Three Arc Lamps in Series.—The beginning of a long abstract with curves and tables, of the article noticed in the Digest May 6.—Wedding. *L'Elec.*, May 20.

DYNAMOS, MOTORS AND TRANSFORMERS.

REFERENCES.

Heating of Commutators.—A short article which seems to be an abstract of one of Parshall and Hobart's series of articles in Lond. *Engineering;* the present one refers to a method of estimating the commutation losses; the formulas are reproduced.—Dix. Lond. *Elec. Rev.*, May 26.

Contact Resistance of Brushes.—A long abstract with tables and data of the article noticed in the Digest Jan. 28.—Arnold. *L'Eclairage Elec.*, May 13.

Calculating Motor Starting Switches.—Description of several methods of calculating such resistances.—Lond. *Elec. Eng.*, May 19.

Alternating Current Motors.—Brief illustrated descriptions from patent specifications.—Guilbert. *L'Eclairage Elec.*, May 13.

POWER.

REFERENCES.

Portable Air Compressor.—A brief illustrated description of the one used in the erection of the steel work of the new post office building in Chicago, in which compressed air is used for riveting hammers. It is mounted on four wheels, is very compact, weighs 1400 pounds and has a capacity of 50 cu.ft. of free air per minute.—*Eng. News*, June 1.

Large Engines.—Data concerning some large engines, including the 4500-hp engine which is being built by the Metropolitan Street Railway Company of New York.—*St. R'y Jour.*, June.

Dust Destructors.—A short article unfavorable to dust destructors.—Lond. *Elec. Rev.*, May 19.

TRACTION.

Three-Phase Transmission Near Philadelphia.—The line from Philadelphia to West Chester, 20 miles long, is described in the *St. R'y Jour.*, June, the interesting feature being that three-phase transmission is used for the distant end. The road has two stations, a main station about 2 miles from the eastern terminal, containing two 400-kw generators and a 250-kw rotary converter; and a substation about 12 miles from the eastern terminal, containing a second 250-kw rotary converter. The first is operated from the trolley circuit, and the alternating current is raised to 6600 volts by means of transformers, transmitted to the substation, and reconverted to 550-volt direct current for use on the trolley line. Both rotary converters are supplied with governors, which open the circuit in case the speed exceeds 30 per cent. above normal. A diagram of the rotary converter connections is given. The company transports considerable merchandise, including milk, a special type of milk car being shown.—*St. R'y Jour.*, June.

Indian Head.—A description of the electric railway recently installed by the government at the proving grounds near Washington. As the railroad crosses the firing lines where overhead wires would be in danger from projectiles, a surface system of conducting the current to the cars was imperative. It consists of knobs or blocks located at intervals of about 15 feet, and the current is communicated to the car by shoes carried under the cars.—*St. R'y Jour.*, June.

Receipts from Railways.—The *St. R'y Jour.*, June, gives a statement by Mr. Rogers, president of the New York State Street Railway Association, at a hearing before the governor of New York state on the question of taxing franchises. The statement shows that of the 103 street railways in New York state, 49 showed a surplus in the past year, and 54 a deficit; only 18 declared dividends, and of these 5 were in New York City. The street railway companies paid in taxes during 1898 28 per cent. of their net income; the elevated roads 46 per cent. and the steam roads 29 per cent. The average dividends paid by the street railroad companies were 2.3 per cent.—Rogers. *St. R'y Jour.*, June.

The same issue contains an address by Gager in opposition to a bill to tax railway companies in Connecticut for their franchises. He shows that railway companies are not making a large profit, and that they impose no additional burden on the highway.

Air Brakes on Street Railways.—Some information concerning the use of air brakes on the street railways of Europe is given in the *St. R'y Jour.*, June. Leipzig has 250 motor cars equipped with air brakes. Each car is taken into the repair shop once in three months, and the compressor is taken apart and cleaned. Prague has 40 motor cars equipped with air brakes. Among the German cities which have adopted air brakes are Munich, Nuremberg, Düsseldorf

and Oberschlesishebahn, the gauge of which is about 750-mm. The brakes are also in use in Brussels and Paris, in which municipal regulation provides that all motor cars operating trail cars must be equipped with a brake which can be set from any platform of the train. In Liverpool, London and South Staffordshire air brakes are also in use.—*St. R'y Jour.*, June.

Electrolysis of Water Pipes.—The litigation in Peoria is summarized in the *St. R'y Jour.*, for June. Suit was brought by the water company for alleged damage to its pipes; the case is now on trial and is looked upon as a test case. A number of experts for the water company were examined and testified that the double trolley system as used in Cincinnati was the only remedy for the trouble. In rebuttal the railroad company had other experts who showed that the return system was excellent, and that the double trolley system was inconvenient and objectionable. Engineers of railway companies representing $200,000,000 of investment stated that they had no trouble with electrolysis. The fact was also brought out that the water company had located gate boxes connected with its water pipes in metallic contact with the rails of the electric road, and this had diverted some of the current to the water pipes. It was also shown that lead pipes were much more subject to electrolysis than iron pipes, as lead sulphate reduces the earth's resistance, whereas oxide of iron acts as an insulator.—*St. R'y Jour.*, June.

Portable Air Compressing Apparatus.—A description of an apparatus used for cleaning car cushions, and operating a pneumatic tool for chipping, calking, riveting or drilling, etc. The compressor is operated by electricity, the motor being arranged on the top of the compressor, and connected to the compressor crank shaft by means of a gear and pinion of special pattern composed of sections of a true helical form, making their operation practically noiseless and greatly increasing their durability.—*St. R'y Jour.*, June.

Automobiles in Paris.—An illustrated description translated from *La Nature*, describing and showing the type of automobile used for public purposes, and the charging station, is published in the *Sc. Am. Sup.*, May 27. As has already been stated, some of these are now in service, and if they are a success 1000 will be put in service for the Exposition next year. The following points may be of interest: The wheels are provided with rubber tires, but not pneumatic, for fear of accidents; the rear wheels drive and the front are used for steering; the single motor is bipolar, has a capacity of 3.36-kw at 80 volts; it drives with a differential gearing by means of a chain; there are 43 accumulators weighing 1620 pounds, the total weight of the carriage being 4400 pounds; the capacity of the batteries is said to be 135 ampere-hours, and enables a trip of 36 miles to be made with one charge; it seems that the cells are connected in series and multiple for obtaining the desired speeds; there are three brakes; one an electric brake, another a block brake applied to the rim of the hind wheels and the third, a band brake, acting on the hub. The authorized speed must not exceed 9.5 miles per hour; the energy absorbed is somewhat more than 350 watt-hours per mile run on the level. The station for the production of the power is briefly described and illustrated; the new charging stations will cover a space of eight acres. Around the establishment there is a course 3300-ft. long paved with various kinds of pavement and including grades from 5 to 10 per cent., as also a number of obstacles, for the purpose of training the drivers.—*Sc. Am. Sup.*, May 27.

REFERENCES.

Belgium.—A report for 1898 of a suburban railway company having in operation 76 lines aggregating 1643.63-km in length. Of these, 73 are operated by steam, 1 by horses and 2 (31.13-km) by electricity. In addition the company will equip three other lines with electricity. —*St. R'y Jour.*, June, Int. Ed.

Hanover.—A digest of the last annual report of the street railway in Hanover, which uses the mixed system of accumulators and trolley. This report shows the maintenance cost of accumulators to be 43.88 marks per car per month, in addition to a yearly depreciation of 6 per cent.—*St. R'y Jour.*, June, Int. Ed.

Omaha-Council Bluffs.—An illustrated description of this railway aggregating 25 miles, which is said to be one of the oldest electric railways in the country, having been started in 1888. Another article describes at some length the accounting system used on that railway. —*St. R'y Rev.*, May 15.

Electric Locomotives.—A reprint of the portion of the paper noticed in the Digest June 3 and 10, referring to tractive resistance.—McMahon. *St. R'y Jour.*, June.

Road Wagons and Motors.—A short article claiming to give a concise statement of the actual standing of the motocycle and motor at the present time. The author seems to be very decided in his views. —Dolnar. *Amer. Mach.*, June 8.

Submarine Navigation.—A translation from the French journal *L'Illustration* of an article on the progress of submarine navigation, containing many illustrations of the various boats.—*Sc. Am. Sup.*, June 3 and 10.

Installations, Systems and Appliances.

Switchboard Voltmeters.—In an editorial in the Lond. *Elec.*, May 26, the question of the best method of maintaining the pressure of a central station system constant, is discussed. The voltage should be regulated from one instrument, and as there are generally numerous feeders, the problem is not a simple one. No solution is offered, but the method in Berlin is referred to favorably; there the distributing network has over 100 feeding points and each pilot wire is connected through a small resistance to a pair of what might be called pilot-wire bus bars, to which the single voltmeter is then connected. In comparing electrostatic and electromagnet voltmeters it is stated that when the energy in the latter is capitalized, its value exceeds greatly the difference between the first costs of the two instruments.—Lond. *Elec.*, May 26.

REFERENCES.

Large Isolated Plant.—A description of what is said to be the largest isolated electric lighting plant in the world, is given in *Power*, June. It is the plant for the Hotel Waldorf-Astoria, New York City. It has a boiler capacity of 4000-hp, electric generators developing 1500-kw, a capacity of 25,000 lamps, and includes a refrigerating and pumping plant and 56 motors; the description is long and contains many illustrations.—*Power*, June.

Wires, Wiring and Conduits.

REFERENCES.

Decay of Vulcanized Rubber.—An article in which it is suggested that the cause of the decay of vulcanized rubber is the action of either the free or the combined sulphur on the copper, in spite of the tinning, the result being that both the rubber and copper are affected. He believes that the properties of pure india rubber adapt it to take the place of the vulcanized compounds for electrical purposes, a statement with which that journal, in an editorial, expresses disagreement.—Terry. Lond. *Elec.*, May 26.

Calculating Wiring.—The conclusion of the article noticed in the Digest May 27. He describes an approximate and more simple method of calculating networks of wires.—Vallee. *L'Elec.*, May 20.

Electro-Physics and Magnetism.

Coherers.—In a French Physical Society paper, noticed briefly in Lond. *Elec.*, May 26, Mr. Broca gives the results of investigations by Blondel and Dobkevitch to determine the effect of different metallic powders and electrodes on the sensitiveness of coherers. If thoroughly clean platinum electrodes are used, it was found better to employ oxidizable metals for the powder; silver, gold and platinum did not decohere, and oxidizable metals decohered better the more they were oxidized, although the maximum sensitiveness was obtained when they were oxidized only very slightly. Branly's success in obtaining both coherence and decoherence with gold filings is attributed to his not having used platinum electrodes. The best results seem to have been obtained with a non-oxidizable metal alloyed with a small quantity of an oxidizable one; excellent results were obtained with chrome, iron and alloys of silver with copper or nickel; a silver-copper alloy was specially suitable. A vacuum is essential in order to make coherers last.—Broca. Lond. *Elec.*, May 26.

Electrolytic Coherers.—Tommasina investigated the properties of liquids with reference to electromagnetic waves and describes the results in the *Comptes Rendus*, May 1. He immersed a copper disc and a pendulum bob in distilled water, both having been previously coated with electrolytic copper. On passing a current a black deposit was formed until a chain of the particles joined the two electrodes; when the distance is very small a chain is formed simply by the action of electromagnetic waves, and on this principle he has constructed a coherer.—Tommasina. *Comptes Rendus*, May 1; abstracted in *L'Eclairage Elec.*, May 20, and more briefly in Lond. *Elec*, May 19.

Thermo-Electric Couple of Constant E. M. F.—*L'Ind. Elec.*, May 10, mentions briefly a note of Prof. Barrett presented to the Royal Society, of London, on a thermo-electric couple formed of an alloy of nickel, manganese and iron as one element, and very pure commercial iron as the other. This couple has the remarkable property of giving a constant e. m. f. for temperatures of the hot junction be-

tween 450 and 950° C. Its e. m. f. for this constant value is 3.7 millivolts and the resistivity of the alloy (the proportions of which are not given) is 97 microhms per cm at 15° C. with a very small temperature coefficient.—*L'Ind. Elec.*, May 10.

Energy of Röntgen Rays.—A paper by Mr. Mowfat, read before the Royal Society of Edinburgh, Jan. 9, is noticed briefly in Lond. *Elec. Eng.*, May 19. He assumes that the "transformation coefficiency" of radiant energy into luminescence is not more than about 4 per cent., and that this ratio holds good for Röntgen rays. On this assumption the rays produce 500 times the effect of the sun concentrated on a square centimeter; as he thinks this is too high, he concludes that the coefficiency of transformation of cathode rays into Röntgen rays must be very small. He thinks it evident from his result that a true average power of the Röntgen rays, that is, their energy divided by their duration as such, is much greater than is generally supposed, and that about 10 gram calories per second may be taken as the lower limit of its magnitude. No further information is given in the abstract, except that with his apparatus the Röntgen rays produced corresponded to about 73 watts.—Mowfat. Lond. *Elec. Eng.*, May 19.

Mercury Arcs.—A description of a convenient form of such a lamp, which is of use for giving monochromatic light of great intensity. A large tube is partially filled with mercury; a concentric tube inside of it passes through the bottom and through the mercury just to the level of it, thus dividing the mercury into two parts; the arc plays between these two over the edge of the inner tube; it is lit by shaking the tube until the two surfaces come in contact.—Fabry and Perot. *Comptes Rendus*, May 9; noticed briefly in Lond. *Elec.*, May 26.

REFERENCE.

Black Radiators.—A paper on a careful investigation at the Reichsanstalt of the black coating of a thermopile bolometer, or radiometer; the radiation can be directly compared to that of an absolutely black body. He concludes that platinum black is the best for most purposes.—Kurlbaum. *Weid. Ann.* No. 4; abstracted briefly in Lond. *Elec.*, May 26.

Cooling Action of the Electric Spark.—An investigation of the properties of a spark traversing air by means of which it reduces the temperature of a neighboring glowing wire or filament. It is thought that this action of the spark is a mechanical one; the gas projected from the neighborhood of the sparks cools the wire.—Villari. *Nuovo Cimento*, January; noticed briefly in Lond. *Elec.*, May 12.

Decomposition of the Current into Disruptive Discharges.—An abstract of a French Physical Society paper on the decomposition of a high potential current into a series of disruptive discharges; the investigation was made by means of photographs of the discharges.—Abraham. *L'Eclairage Elec.*, May 13.

Oscillatory Discharge of a Condenser.—A discussion of a previous Physical Society paper (see Digest, April 29), on the criterion for an oscillatory discharge.—Morton and Barton. Lond. *Elec. Rev.*, May 19.

Magnetic Susceptibility.—Abstracts of three articles; one on the temperature variation of the magnetic susceptibility of anisotropic bodies in different directions, by Lutteroth, from the *Wied. Ann.*, December; another on the magnetic susceptibility of solid and liquid bodies, by Koenigsberger, from the *Wied. Ann.*, November; another on magnetic susceptibility and molecular magnetism, by Jaeger and St. Meyer, from the *Wied. Ann.* 63, p. 83.—*L'Eclairage Elec.*, May 20.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolysis of Copper Sulphate Solutions.—Mr. Foerster, in the *Zeit. f. Elektrochemie*, May 4, gives the results of what appears to have been a very extended investigation of the electrolysis of copper sulphate solutions. Among other matters of interest he found the following: The hardness and strength of the electrolytic copper were found to increase independently of the concentration of the bath, when the current density increased; with a 20 per cent. copper sulphate solution as high as 2.2 to 2 amperes per sq.dm. is still allowable. The elastic limit with such a solution was greatest with a density of 1 to 1.5 amperes and with less dense solutions it diminished. The toughness was greatest below 0.6 amperes with the same solution. He found that the temperature of the bath had an important effect on the mechanical properties of the copper; at 40° C. the deposit was especially fine and regular and was quite tough. The results of this test are given at some length. The electrolyte consisted of 125 gr. of copper sulphate and 50 gr. of soda in one liter; the solution was kept stirred; the current density was about 1 ampere per sq.dm.; the deposit was nearly 2-mm thick and was easily stripped from the cathode; this was then cut into strips which were tested for tension. The results show that at 25° and 40° C. an especially tough copper is obtained; with higher as well as with lower temperatures the toughness is diminished; at higher temperatures more dense copper is obtained than at 20° C.; but in all cases the mechanical properties of the copper are still quite considerably below those of pure wrought copper, approaching the latter more closely when the deposition was at 35° to 40° C. He also found the effect of temperature on the slimes precipitated in the electrolytic refining of copper; at 40° C. this slime contained only a very little copper, the current density being one ampere per sq.dm., showing that at the high current densities now used, the working up of the slimes became simpler; when the temperature was 60° the quantity of the slimes increased and was found to contain considerable copper. He seems to question, however, whether the extra cost of the heating and the larger conductors required for the greater current density would be profitable in the electrolytic refining of copper. The mechanical properties, moreover, are of importance only when the metal is to be used as it was deposited, as, for instance, in the formation of tubes by the Elmore process. He also found that even a trace of organic substances in the bath, such, for instance, as that obtained from rubber, which had been used to coat parts of the plate for insulation, have a very decided detrimental effect on the structure of the copper deposit; he therefore recommends using clay, glass or other material for insulation purposes rather than organic substances. Huebl, whom he quotes, also found that many failures in electrolytic deposits have been due to the presence of organic matter in the bath.—Foerster. *Zeit. f. Elektrochemie*, May 4.

Electrolytic Bleach.—Some data giving the results of a practical test are published by Mr. Engelhardt in the *Elektrochem. Zeit.*, May 2. The tests were made on a large scale in a bleaching establishment by Dr. Prelinger with the Kellner apparatus. The electrodes are made of glass plates around which is wound platinum-iridium wire. The circulating apparatus consists of a collecting vessel with a cooling worm, the liquid being kept in circulation by means of a hard rubber centrifugal pump; the circulation keeps the temperatures at about 20° to 25° C. in order to prevent the formation of the inactive sodium chlorate, which involves a loss of power. The results, which are given in some detail, were obtained from a 12-hour run; according to these 1-kg of chlorine costs 14.4 cents, including the cost of the salt, the power and 10 per cent. amortization of the apparatus. In the bleaching tests the material was boiled in the solution; 33,800 meters or 2800-kg of a light cotton goods were bleached at a cost of about $1, including the subsequent washing; the cost by the former process with chlorate of lime was $3.33. There was thus a saving of $2.33. Another test with 3450-kg of heavy cotton goods showed a saving of $3.02. It might be added that these results were obtained where the conditions for getting water are unfavorable.—Engelhardt. *Elektrochem. Zeit.*, May 1.

Salammoniac-Calcidum for Leclanche Cells.—Some years ago a German company began making a material which it called calcidum, the solution of which is to be used in Leclanche cells in place of the usual salammoniac; its composition appears never to have been described and is apparently kept a secret. A description with the results of what appears to be a long comparative test by Dettmar made last July, is given in the *Elektrochem. Zeit.*, May 1. Two cells were tested together, one with the usual salammoniac solution and the other with this compound, all other conditions being exactly alike. On open circuit they gave practically the same voltage, namely, 1.633 for the one with salammoniac and 1.657 for the one with salammoniac-calcidum. Each was discharged through an external resistance of 10 ohms and the difference of potential was measured periodically for 45 days; at the end of that time the former gave 0.250 and the latter 0.330-volt; the former had a capacity of 72.0 watt-hours and the latter 96.7. The additional output of the latter during the first 15 days was 25 per cent.; during 30 days 30 per cent. and during 45, 33.6 per cent. The former dropped to 0.8-volt after 23.3 days, and the latter after 30.6 days, showing that the latter is quite appreciably better. If the average value of the lowest voltage is taken as one volt, the latter cells are 2.5 times as good as the former. A note added by the manufacturer states that after this test the zinc in the former was found to be covered with a hard layer of oxide, on the removal of which the zinc was found to be badly perforated, while in the latter the zinc was bright and was not irregularly corroded.—*Elektrochem. Zeit.*, May 1.

Accumulator.—A brief illustrated description of a form of accumulator in which the plates are placed one above the other, each one forming a cell, being positive on the lower side and negative on the upper, is given in the *Elek. Zeit.*, May 11. The plates themselves are concentric rings with vertical axes, the positives of which are fastened to the bottom of one tray and the negatives to the upper side of the next lower tray; thus the active surfaces are vertical and parallel, each plate really consisting of a short, thin, hollow cylinder; for this reason there is less fear of buckling than there is in large flat plates. Such plates can be piled to the height of one or two meters, a pile representing a voltage from 30 to 60, the floor space occupied being only twice as great as that of a single cell of an ordinary accumulator of like capacity. The weight is said to be about the same as for stationary batteries while the floor space is much less, the saving being about 75 per cent. A cross-section and an external view are given. The advantages which are enumerated, are well known, the idea not being a new one. It has been claimed that a disadvantage lies in the fact that the plates cannot be examined, but this he says is not necessary, as the fear of the plates coming in contact is very slight in this form.—Triblehorn. *Elek. Zeit.*, May 11.

Galvanic Cell.—A brief description of the Exner and Paulsen cell is abstracted in the *Elektrochem. Zeit.*, May 1, from the *Elek. Rundshau.* The electrodes are peroxide of lead and zinc; the solution is a very weak one of sulphuric acid with saccharic acid and a solution of sulphate of mercury in ether. To protect the zinc a weak gelatine solution is added which coats the zinc electrode and prevents its attack, as this gelatine is not destroyed by the weak acid solution. The cell is charged like an accumulator and is used as a primary cell; it has a voltage of 2.5 and when at rest the electrodes are not attacked. The advantage of this over the usual form in which acetic acid is added to the sulphuric, is that the acetic acid attacks the peroxide of lead plates; moreover the electrolyte is too weak to decompose the gelatine surrounding the zinc. The addition of the mercury salt adds to the protection of the zinc.—*Elektrochem. Zeit.*, May 1.

Electrical Energy Direct from Carbon.—A brief reply by Cooper to the recent article of Tommasi (see Digest June 3). He claims that it is difficult to follow the explanation of the theory given by Tommasi. He questions what the electrolytic compound is, which is formed when carbon is an ion. The oxidation of carbon when a current passes is not nesessarily a source of electrical energy; if the voltage between a carbon plate and one of lead peroxide in sulphuric acid, namely, 0.9, is due to the oxidation of the carbon, it should be altered considerably by substituting platinum for the carbon, but this is not the case.—Cooper. Lond. *Elec. Rev.*, May 26.

Units, Measurements and Instruments.

Wehnelt Interrupter.—A note by Mr. McClenahan is published in *Science*, May 26. He endeavored to test whether the action of the circuit breaker could be due to a spheroidal state produced by the high temperature, and in order to determine this he used electrodes of fusible metals melting at various temperatures. His experiments seem to show that the temperature of the electrode was far below 200° C., which is the temperature necessary, at atmospheric pressure, for the production of the spheriodal state. He also found that induction in the circuit is essential to the action of this interrupter, a fact which has been repeatedly demonstrated.—McClenahan, *Science*, May 26.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—The experiments which are being made by General Greely, of the Signal Corps of the United States Army, are briefly described in the *Sc. Am.*, May 27. Experiments have been begun for fairly testing this system for military and other purposes; special forms of apparatus have been constructed and have shown sufficient promise to warrant further trials. As the source of the waves, a coil energized by a three-quarter horse-power rotary transformer, furnishing an alternating current of 12.5 volts, was used in the place of the Ruhmkorff coil, and the arrangement is said to make a very powerful and efficient source of Hertzian radiation. As yet the transmission of regular messages is unreliable and uncertain. A supply of balloons has been obtained and they will be used in the near future in order to obtain the proper height for the vertical wires. He considers the system of Hertzian wave telegraphy to be very useful for communication between lighthouses, lightships and the shore, or between naval vessels, but does not believe it will supplant ordinary commercial telegraphy by wire. The use of metal reflectors for directing the radiation has met with partial success and should be thoroughly investigated. Experiments are soon to be made by the Lighthouse Board on Staten Island. The instruments are of the Clarke type.—*Sc. Am.*, May 27.

Miscellaneous.

Steering Torpedoes by Ether Waves.—A description, taken apparently from a patent specification, of an invention by Jamieson and Trotter, is published with illustrations in the Lond. *Elec.*, May 19. A large model has been tried and has been "an entire success," working without a hitch under all kinds of conditions. Hertz waves are used for controlling the current which operates the steering mechanism. The general principle is that the coherer operates a relay which in turn switches on or reverses a local current which operates the steering mechanism. The description is of the kind usual in patent specifications and endeavors to include a large number of variations in the method. In general, there are two staffs projecting four feet above the surface of the water, which receive the waves and are in circuit with a coherer; the latter has no loose contact and there is no trembling during cohering. The current from the relay flows through what is called a selector which turns the helm either to the right or to the left; when the secondary current ceases the helm flies back to its normal position and this turns the selector a half revolution so that the torpedo can then be steered in the opposite direction; it may be steered in the same direction if two waves are sent in quick succession. There is an electric coupling which allows the rudder to fly back as soon as the current ceases. The methods of effecting many of the operations are kept a secret.—Lond. *Elec.*, May 19.

Electric Treatment of Gout.—Mr. Guilloz, in *Comptes Rendus,* abstracted briefly in the Lond. *Elec.*, May 19, states that he has obtained good results by the electrolytic transport of lithium across the affected joint; he uses strong currents up to 150 and even 200 milliamperes and passes them for 20 to 30 minutes; the pain rapidly diminishes and there is a permanent improvement in the joint and a reaction upon the general nutrition, which is accelerated; in the case of obesity the treatment tends to decrease the weight. The principle of this treatment is that anything which increases the local nutrition is likely to be beneficial. He applied the same treatment to chronic rheumatism, but without satisfactory results.—Guilloz. *Comptes Rendus,* May 1; abstracted in Lond. *Elec.*, May 19.

New Books.

ELEKTROMOTOREN FUR GLEICHSTROM. By G. Roessler. Berlin: Julius Springer. 140 pages, 49 diagrams. Price, 4 marks.

This work, by Dr. G. Roessler, professor at the Royal Technical High School, Berlin, Germany, is written particularly for mechanical, steam and hydraulic engineers and others whose profession is brought into contact with power transmission work, and who wish to familiarize themselves with the nature and character of direct-current dynamos and motors and their behavior. The author states in the introduction that he has aimed to present in a condensed form the important and fundamental parts on the subject, and further to preserve clearness by reducing the use of long and complicated formulæ as much as possible, so that the result to be obtained is not lost sight of by the development of numerous equations. In this respect the author has been successful, as he dwells in a short and comprehensive manner on the subject, yet remaining at all times scientifically correct.

Although knowledge of mathematics is required to be benefited by the study of the book, it does not contain any long calculations, and the mathematics used is readily understood by those for whom it is intended. For these it will solve many questions and should be a valuable reference book. The addition of a chapter on absolute system of measures is of value. The relation between mechanical and electrical units is often not understood and is such a stumbling block to engineers. In chapter I are described the fundamental laws regarding pressure, resistance and currents and modes of ascertaining their units; chapter II, treats of magnetism, the characteristic of magnetic fields with special reference to dynamos, and of induction motors, induction, etc. This is followed by chapters on torque, counter e. m. f., use of the same machine as generator or motor, shunt, series and compound wound dynamos, electric brakes, armature reaction, sparking at commutator, Foucault currents, hysteresis and system of absolute measures. This vast subject matter is success-

fully condensed in a small book of 135 pages, and should be of special service to men who operate direct-current dynamos and motors and wish to have a knowledge of the underlying laws, which knowledge is so essential to keep dynamos in proper operative condition and prevent trouble.

BOOK RECEIVED.

THE COMMERCIAL AND BUSINESS ASPECTS OF MUNICIPAL ELECTRICAL SUPPLY. A Practical Handbook. By Alfred H. Gibbings. Bradford, England: Alfred H. Gibbings 1899. 270 pages, 57 illustrations. Price, $5.00.

A Frictionless Wattmeter.

BY WALLACE D. WHITE.

THE great interest of central station managers to secure maximum economy in the generation and distribution of current has led to such improvements in the development of electrical appliances that small opportunity for further advance in this direction appears to be possible.

The efficiency of boilers, engines, generators, transformers and other apparatus has been so carefully studied as to make a further saving of one per cent. apparently very difficult. The manager is generally familiar with the exact ratio existing between output and the many and varying losses in generating and transforming devices; but an important element of loss which has received comparatively slight attention is the matter of metering the current distributed, and this is capable of great improvement.

It may not be generally known that some wide-awake engineers who have investigated the subject assert that the actual loss attributed to this source alone frequently amounts to four, five or six per cent. of the energy delivered to the consumer. That an analysis of existing conditions should reveal such a state of affairs is rather discouraging, particularly in view of the prevailing tendency toward better rates to the long-hour customer, without reducing, farther than necessary, the rates to the short-hour users. It is the short-hour user chiefly who derives a benefit from the failure of meters to register on small loads, to say nothing of the small return upon investment of the supply company, since instruments of large capacity are required, and in the writer's opinion none have heretofore been available which would register and continue to accurately record the current in circuit at times of small demand.

An instance of common occurrence is that of one lamp burning perhaps twelve hours per day. Through a meter of, say, 50 lights capacity, its current, which would show no record, would amount to 360 lamp-hours per month, 4320 lamp-hours per year, or (were the average daily use of the entire installation from one to one-half hour per day), from 24 to 48 per cent. of the current recorded and charged for. It needs no mathematical demonstration to show that a meter which would record *freely* and *accurately*, the current of any number of lamps, from a single 8-cp lamp to the maximum for which it is designed, would not only avoid such failures, but prove a most excellent investment as well.

But in addition to this, wattmeters have other and more serious defects. They require frequent inspection, attention, repairs and renewals, which render them a source of annoyance to the consumer, and of care and expense to the station manager. Manufacturers have issued instructions and special precautions for the maintenance of their wattmeters, and in many stations a corps of meter inspectors and assistants, with the consequent test-room, test-records, standard instruments, tools and equipment are required, and despite all efforts to the contrary, results are far from being satisfactory. Furthermore, to minimize the small-load losses, a stock of meters of many sizes is kept on hand, and it not infrequently happens that an increase in installation requires a change of meter.

In all wattmeters having jeweled supports, or bearings, for the moving system, friction is unavoidable, and is the principal cause of inaccuracy and endless difficulties. After years of patient investigation and experiment, with jewels and other supports for meter armatures, Mr. William Stanley found that the best mechanical bearings, while they may be reasonably sensitive when new, rapidly deteriorate in use, and he insists that no mechanical device, such as a sapphire bearing with a polished steel staff, can ever be durable and frictionless in an inductive wattmeter where the shunt circuit continually causes a slight tremble or rubbing between the staff and jeweled bearing. This occurs, under the most favorable conditions, in the instruments on alternating current circuits within two to eighteen months, and the destruction results largely from the rubbing between the bearings caused by the vibrations set up by the flux from the shunt circuit.

In the wattmeter recently exhibited at the Electrical Exhibition, New York, by the Stanley Instrument Company, the results of Mr. Stanley's labors were exemplified in a practically *frictionless* watthour meter of unsurpassed sensitiveness, accuracy and mechanical design. The novelty of this new meter lies in supplanting the critical

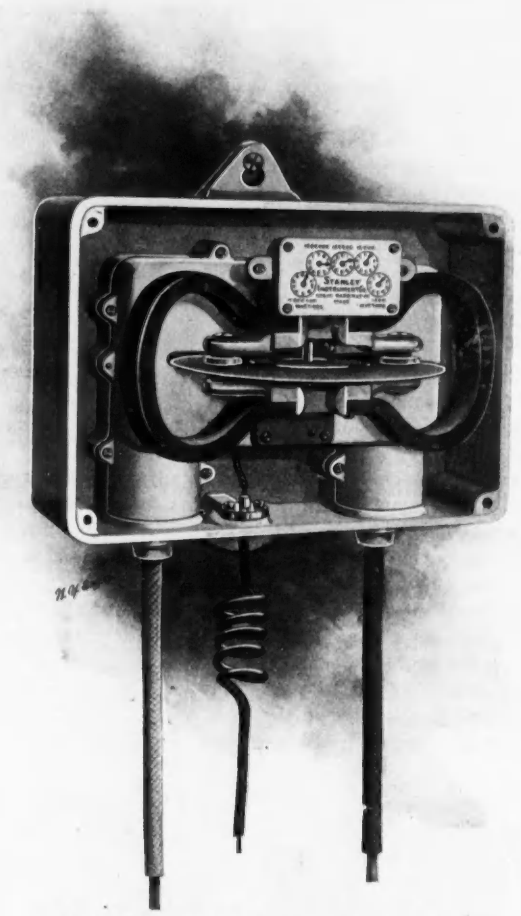


FIG. 1.—FRICTIONLESS WATTHOUR METER.

and short-lived element—the main jewel of other meters—by a magnetic lifting force which, having no mechanical properties, can therefore never wear out, and which is so applied in the new device that it performs its function of supporting the meter armature without friction. In dispensing with mechanical supports for the moving system of this instrument, one of the greatest, and hitherto insurmountable, difficulties has been overcome in a very novel manner.

It appears that the designers of the Stanley instrument have struck out boldly to remedy at one blow most of the meter troubles with which electric companies are contending. They have supported their armature without a bearing to wear out; have made meters of large capacity which will do perfectly all the work of smaller ones, and have combined their improvements in a mechanically well made, carefully cased, protected and sealed instrument. An aluminum disc rigidly secured to a soft steel core is suspended in space,

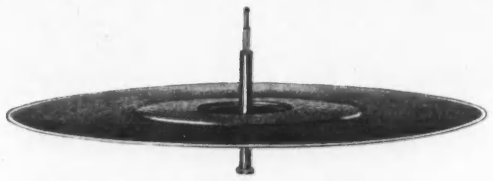


FIG. 2.—ALUMINUM DISC.

being *floated* in a magnetic field which acts upon the core, holding it in a definite, fixed position between the poles of two permanent magnets. The core forming an armature, terminates at the upper end in a hardened, polished steel staff carrying a pinion; the lower end being recessed and fitted with a phosphor-bronze ring accur-

ately set in line with the staff. In the lower pole-piece is a hardened and polishd stationary steel pin which enters this ring and guides the core. The magnetic field of the permanent magnets attracts in an upward direction the core and disc supported thereon, counterbalancing the effect of gravity, and lifting them free from mechanical support. This unique method of support is termed "magnetic flotation," and no matter how violently the core and disc may be vibrated, the instrument cannot be injured thereby, and the coefficient of friction is negligible.

The aluminum disc is perfectly true, being stiffened by "checkering" in a press, and being balanced both mechanically and electrically, it has no "dead point" which would cause it to swing

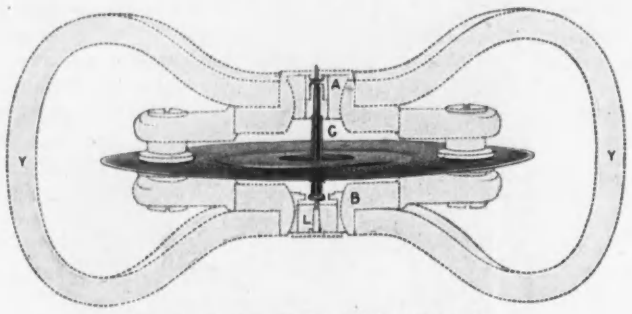


FIG. 3.—MAGNETIC FLOTATION SYSTEM.

around were the staff not exactly vertical. These features make it possible to test and seal the instrument at the factory and being shipped without blocking up the disc, no adjustment or recalibration is necessary when connected for use. It is sensitive and accurate from less than one per cent., throughout the entire range of its capacity; and starting and stopping instantly when a small load is thrown on or off, it will make a positive and accurate record. Nor is full-load accuracy sacrificed in attaining this result—the large consumer being quite as equitably charged as the one having a large installation but using only a small fraction of the same under ordinary conditions.

A peep-hole is provided in the case cover through which revolutions of the disc for a known load can be counted, and registration

AIR SPRING PRESSURE REGULATOR.

checked. Beyond this, absolutely no attention is required; and the instruments being guaranteed for a period of years, all annoyance and expense heretofore necessary to maintain accuracy in the commercial use of watt-hour meters is obviated—the importance of which to the central station manager cannot be over-estimated. And if the results of experience justify the confidence of the Stanley Instrument Company in the continued good performance of its meters, electric lighting companies will undoubtedly reap a substantial benefit from their use, and the guarantee covering their performance for years offers a simple and complete solution of many perplexing problems.

Air Spring Pressure Regulator.

The pressure regulator or reducing valve shown in the accompanying illustrations, in perspective and in section, is constructed on new lines, the novelty of the apparatus consisting in the use of air as a spring instead of metal spring, levers or weights, and in the application of the muffler principle, which gives a noiseless regulator. The air spring is formed in an air-tight chamber, of which the diaphragm (which carries the main valve) forms one side. With a bicycle pump, air is pumped into this chamber, and its pressure on the diaphragm pushes the valve open and holds it open until the low pressure on the opposite side of the diaphragm forces it to its seat. It is evident, therefore, that any high pressure is regulated by simply pumping air into the chamber, and any lower pressure by letting air out of the chamber, while the air itself forms an elastic spring, fully supporting every part of the surface of the diaphragm on one side against the equal pressure of the fluid on the other side. The diaphragm is simply an elastic partition between two equal pressures. The valve is double-seated, balanced and frictionless, and is influenced by the slightest change in pressure, while the sensitiveness of the air spring is entirely controlled by the size of the air chamber. The most common and obvious use of this regulator is in steam heating, or where it is desired to reduce any varying high pressure to any constant low pressure. This apparatus is manufactured by D'Este & Seeley Company, 29 Haverhill Street, Boston, Mass.

New Riker Electric Dos-a-Dos.

One of the forms of vehicle to which the electric automobile manufacturers have been paying special attention is the dos-a-dos, whose lightness, compactness and carrying capacity give it a great many advantages. The form herewith illustrated is the latest type brought out by that prolific and progressive concern, the Riker Electric Motor Company. It has a total weight of 2500 pounds, with a 63-inch wheel base and a tread of 56 inches. It is fitted with pneu-

ELECTRIC DOS-A-DOS.

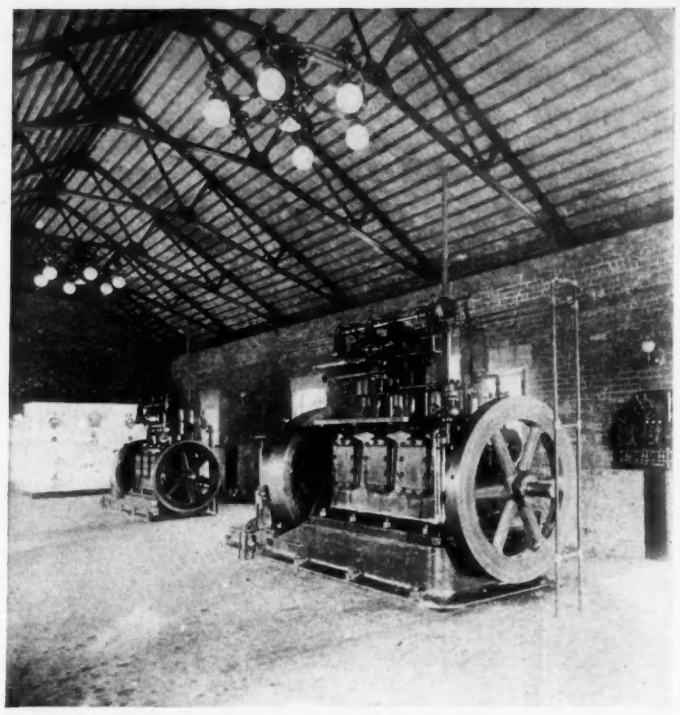
matic tires 3 inches by 32 inches in front and 36 inches in the rear. It carries four passengers and can make a total of 25 miles on level macadam and a maximum speed of 12 miles per hour. It is furnished with one 2-kw motor on the rear axle, the driving being done from the rear wheels and the steering from the front wheels. The controller gives three speeds ahead and two astern.

Electricity for Private Mansions and Hotels.

The Westinghouse gas engine is a new invention in that many mechanical improvements have been added, and the regulation so perfected that it is equal to the most severe requirements of electric lighting. This has opened up a new field of usefulness, enabling many country houses and hotels remote from populous centres to secure in a satisfactory manner the benefits of the electric light.

The introduction of a steam plant into the house or grounds of a private residence is never desirable. Boilers are dangerous without expert attendance, and require much care, besides causing smoke, dirt and ashes. A gas engine can be started at a moment's notice, and stopped with equal promptitude. Gasoline can be used for driving the engine, should there be no gas supply in the neighborhood. There is no disagreeable odor and the apparatus is practically noiseless. The proper illumination of houses is commonly neglected, but nothing adds so greatly to their beauty as an artistic disposition of the lights. Electricity is a safe means of illumination, which is an important consideration for owners of country and suburban places remote from fire stations.

Among recent notable installations of private electric plants driven by Westinghouse gas engines are those at the residence of Mr. George Gould, Lakewood, N. J., illustrated in the accompanying cut, and at the Kirkwood Inn, Scarborough Beach, Me. The Kirkwood Inn is on the coast of Maine, eight miles from Portland, and stands at an elevation of 75 feet above sea level, the house facing the ocean, looking south. From the veranda, a wide sloping lawn, dotted here and there with clumps of evergreens and flowers, reaches to the bluff, and at the foot is the ocean, with a two-mile stretch of beach that is said to be the finest in the world. Behind the house is a thick wood, rivaling the primeval forests in its dense shade. The estate of the Kirkwood Inn includes many acres of woodland, and at night the forest glades are lit electrically. In the midst of these rural surroundings the visitor is astonished to find the comfort and beauty of the electric light.



MR. GEORGE GOULD'S POWER HOUSE.

Standing hidden in the woods away from the hotel is the electrical plant. A Westinghouse gas engine of 30-hp drives a Westinghouse electric generator, and also a triplex pump, gasoline being the fuel employed in the engine. Wires conduct the electricity to light the lawn and grounds. In addition to the interior lighting in every room and the lighting of the lawn and grounds, the veranda is tastefully festooned with electric lights—the hotel presenting a perfect blaze of light that attracts attention from passing mariners many miles out at sea. The pump operated by the gas engine supplies thousands of gallons of water each day. A large ice cream freezer is also driven by the engine. A laundry, which will be electrically operated, is now in course of construction. This plant was installed in the spring of 1898. Its successful and economical operation and its freedom from noise and odor have led to the installation of similar plants in various parts of the country, notably by the Florida East Coast Hotel system, which is installing Westinghouse gas engines at a number of its hotels.

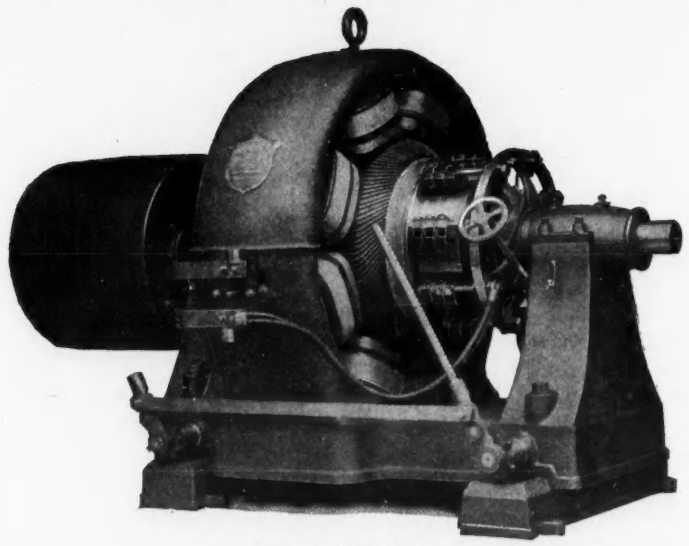
Cutter Arc Cutout.

Several new and unique features have been introduced in the novel loop switch for arc circuits, or so-called "arc cutout," illustrated here with. One of these is the use of a coiled spring so arranged as to give a quick and positive action without the possibility of a "dead centre." Another consists in the adoption of sliding contact shoes of sheet metal, each of which is forced against the terminals by an independent spring chambered in the large insulation disc. This arrangement of the contacts makes them self-cleaning, non-sparking and self-aligning. The insulating parts are all made of porcelain or slate so as to be unaffected by the weather, and the whole mechanism is mounted in a neat glass-front case. Having stood a series of severe tests, this new arc cutout is now being put on the market by the George Cutter Company, of Chicago. The device as will be seen from the illustration is remarkably compact, while the field which awaits its introduction is so large as to ensure it a warm and indespread welcome.

ARC CUTOUT.

Bullock Belted Generator.

The accompanying illustration represents the belted type of Bullock generator, which is made in capacities from 1½-kw to 300-kw, that shown having a capacity of 200-kw. A similar but direct-connected type is built in capacities from 15 to 350-kw. Among the features claimed by the manufacturers of these machines are very high efficiency and workmanship, their new shops being fitted with the latest appliances for turning out the most accurate work. Another claim is that the machines are rated on a conservative basis, contrasting with some machines now on the market, which have been overrated to meet competition.



BELTED GENERATOR.

The Bullock Electric Company, of New York, with offices in the St. Paul Building, handle the Bullock product in the East, and the Western territory is taken care of by the Central Electric Company, 264 Fifth Avenue, Chicago.

NEWS OF THE WEEK.

Financial Intelligence.

ELECTRIC STORAGE BATTERY.—The annual report of the Electric Storage Battery shows gross sales for the year of $2,387,050 and net profits of $260,000 after paying all charges, including a depreciation charge.

EDISON PORTLAND CEMENT.—The Edison Portland Cement Company filed articles of incorporation at Camden, N. J., capital $11,000,000. T. A. Edison is among the incorporators. This is understood to be a development from his magnetic ore milling enterprise.

METAL MARKET.—In the metal market copper has been holding its own at 18½ cents. Just a year ago it was below 12 cents. Heavy steel rail is quoted at $26; steel billets, Philadelphia, at $31; gray forge pig iron, at Pittsburg, $16.25. There has been an expectation that the continuance of a high range of prices would check demand, but so far that has not happened. On the contrary, orders continue very heavy.

COMBINATION IN CONNECTICUT.—The Central Railway & Electric Company, of New Britain; the Waterbury Traction Company, Naugatuck Electric Light Company, Norwalk Gas Light Company, Norwalk & South Norwalk Electric Company, the Greenwich and the Housatonic Power Company have been purchased by R. A. C. Smith and associates, who represent a strong syndicate of New York capitalists. Mr. A. M. Young is a leader in this important enterprise.

NEW ENGLAND ELECTRIC VEHICLE.—The New England Electric Vehicle Transportation Company has begun to operate, in a limited way, with the five cabs which it has on hand. It has issued a schedule of rates for hansoms and coupes, in which it makes a charge of $1 per hour within the city limits, $1.50 per hour outside the city limits, and $5 for a tour of the parks, limited to fifteen miles. The rate between any two points in Boston proper is 50 cents for one person and 75 cents for two persons. Newport is to be the next place to receive carriages.

CUMBERLAND TELEPHONE COMPANY.—Col. James B. Speed, president of the Ohio Valley Telephone Company, has just transferred a controlling interest in the stock of the company to the Cumberland Telephone Company at $200 a share. The Ohio Valley Telephone Company has 4000 subscribers in Louisville, Ky., and in several surrounding counties. The Cumberland Company operates under Bell patents in Tennessee, Louisiana and Mississippi. The control of the Cumberland Company is held by the American Bell Telephone Company. It is understood that the Erie Telephone Company was offered a controlling interest in the Ohio Valley Company, at $150 per share, but refused the offer.

A JERSEY MORTGAGE.—There was filed at Newark, N. J., on June 6, in the County Register's office, a mortgage for $20,000,000. It is made by the United States Electric Company of New Jersey, which recently acquired control of electric plants in Essex, Hudson, Union and Morris Counties, to the New Jersey Title Guarantee and Trust Company of Jersey City. The mortgage, which is dated June 1, 1899, is given to secure bonds issued to purchase the control of plants secured by the mortgagor. The document is signed by A. B. Carlton, as president, and Thomas J. George, as secretary of the United Company, and A. J. Garretson, as president, and J. W. Hulshizer, Jr., as secretary, for the New Jersey Title Guarantee and Trust Company.

CHICAGO UNION TRACTION.—It comes from good authority that the earnings of the North and West Side lines, as shown by the Whitney-Elkins experts, are much higher than those shown by the published statements of the two companies. The report for 1898 showed that the North Side Company earned 13.6 per cent. on the stock and the West Side 6.1 per cent. Under the proposed guarantee, the North Side is to receive 12 per cent. and the West Side 6 per cent. People have not been able to see how the new company could pay 5 per cent. on the $12,000,000 of preferred to say nothing of the six millions of common, which went with it. It now appears that the actual earnings of the West Side Company were near 8 per cent. and the earnings of the North Side Company near 16 per cent.

BELL TELEPHONE.—The recent increase of the capital stock of the American Telephone & Telegraph Company from $25,000,000 to $75,000,000 was, it is said, for the purpose of purchasing the controlling interest in all the local Bell companies of the United States and supplying money for new extensions of its own long-distance system, and purchasing new stock in local companies to enable the local companies to continue the work of extensions. The American Bell Telephone has already transferred to the American Telephone & Telegraph Company a large portion of its holdings in the local companies. After the transfer is completed it is quite probable that the American Bell stockholders will be given an option to take stock of the American Telephone & Telegraph Company to create a fund for the purposes above mentioned. This plan will obviate the American Bell making any further increase in its capital and furnish all the money necessary.

COLUMBIAN ELECTRIC CAR LIGHTING & BRAKE.—Among the recently organized industrial companies is the Columbian Electric Car Lighting & Brake Company. The company was incorporated with a capital of $10,000,000, with no bonds or indebtedness of any kind, and with sufficient money on hand to carry out the plans and intentions of the promoters. Since its organization the United Electric Company and the American Railway Electric Light Company have been absorbed. The company announces the complete success of its system of railway car lighting, and its availability for practical use of railway service. The company has equipped 1000 cars with its apparatus for the Pullman Palace Car Company, and has received recently an order to equip 6000 more passenger coaches. The company has lighted cars on a number of the leading roads, among them the New York Central, Pennsylvania, Alton, Canada Southern, besides several others. The securities are on the outside market, and quotations at present are nominally 21.

THE WEEK IN WALL STREET was one of general advance. Better feeling prevails, although it is not to be inferred that the market will move upward while the condition of the crops declines. During the week on sales 13,568 shares Western Union advanced from 87½ to 90½. On sales of 3464 shares General Electric advanced from 117½ to 119¾. Brooklyn Rapid Transit on dealings in over 200,000 shares went up 6½ to 116¾, and Metropolitan Street Railway, on 33,615, went up from 211 to 223. Third Avenue R. R. went up 4 points to 189, and Manhattan Elevated, on 118,000 shares, advanced 6¾ to 115. In Boston, American Bell Telephone closed at 332, and Boston Elevated at 108. In Philadelphia, Electric Storage Battery common was 131 and preferred 130½. General Electric Automobile closed at 9, Electric Company of America at 18¼, and Pennsylvania Electric Vehicle Company at 16½. In Chicago, West Chicago Railway sold at 120; other stocks were firm and steady. Outside securities in New York during the week were generally stronger. Electric Vehicle was 112 bid and preferred 120; New York Electric Vehicle, 21¼; New York & New Jersey Telephone, 177 to 185. Electric Boat was quoted at 23, and preferred at 47½. Otis Elevator common 33½, and preferred 87.

STATE OF TRADE.—Reviewing the week, Bradstreet's says: "Exceptional firmness in prices at the highest level as regards general staple values yet reached, a seasonably small rate of business mortality, undiminished industrial activity, perhaps most manifest in all branches of trade in which iron, steel and other metals enter, and large bank clearings, reflecting to some extent the improved tone of stocks, but, likewise, large payments on previous profitable business are among the features not necessarily new, but still noteworthy, reflected in trade advices. Enlarged shipments of breadstuffs, a result of recent buying, induced by crop damage reports at home and abroad, have, it is true, not been sufficient to offset liquidation on the late moderate rise, but this is partially explained by continued good advices from the spring wheat crop, confirmed by liberal receipts at primary points. Iron and steel display all of their old and some new strength in the urgent demand for the balance of the year, and the usual summer shutdown seems likely to be honored more in the breach than in the observance in this trade. Business failures for the week number 178, as against 129 last week, but compare with 221 in this week a year ago, 256 in 1897, 234 in 1896, and 232 in 1895. Bank clearings are of course in excess of last week's small total, due to holidays, aggregating $1,816,125,980, or 32 per cent. larger than last week, and are 37 per cent. heavier than in this week a year ago, 80 per cent. larger than in 1897, are nearly double those of 1896 and 53 per cent. in excess of 1892. Supplementing the reports usual at this period of the year, of quiet midsummer demand at wholesale at the West, are advices of exceptionally good fall orders booked and of improved retail distribution, due to very warm weather. Industrial activity is pronounced in that section, hot weather not checking operations."

NEW YORK NOTES.

THE ELECTRICAL BUREAU of the National Board of Fire Underwriters has issued a second edition of pamphlet No. 4, containing laws and ordinances adopted by various states and municipalities to regulate the installation and use of electrical apparatus. The New York office of the Bureau is at 156 Broadway and the Chicago office, 157 La Salle Street.

THE COMMERCIAL CABLE COMPANY has been notified by the War Department that, under existing conditions, it will be impossible to grant the company's application for permission to land a cable on the coast of Cuba. This action, it is stated, ends, for the present at least, the prospect of a competing company in the cable business from the north side of the island.

AUTOMOBILES AND THE CABMEN.—At the next session of the New York state legislature it is proposed to introduce a bill providing that automobile carriages in the streets shall be in charge of competent electricians. The Liberty Dawn Association of livery coach drivers and the Rising Sun Association of livery stable men propose to fight this provision of the bill. They say that automobiles will drive many horse cabs and carriges off the streets and that it will be unfair to deprive their drivers of a chance to take charge of automobiles.

TO STUDY AMERICAN ELECTRIC VEHICLES.—Mr. Oscar Oliven, an electrical engineer of the Union Electrical Company of Berlin, Germany, is stopping at the Hotel Savoy, in this city. Mr. Oliven has come here to study the electric vehicle industry in this country, after which he will go to Buenos Ayres, where he will superintend the building of a large electric plant and the installation of a street car system. Referring to the electric vehicles which he has already seen in New York, Mr. Oliven made the statement that he regards the average American automobile as far superior to those in use in Paris. Their speed may not be so great, he said, but the makers were wise enough not to sacrifice all the other good points for that of speed. They combine comfort, safety and beauty to a remarkable degree. He said that American electricians are rated high the world over. In Berlin and other European cities they are preferred to natives.

NEW ENGLAND NOTE.

TELEGRAPH CORPS OF THE ASSOCIATED PRESS.—The telegraph operators of the Associated Press in New England met at the American House, in this city, recently and formed an association, to be known as the New England Telegraph Corps of the Associated Press. The following named officers were elected: President, E. M. Fisher, of Boston; vice-president, R. E. Grandfield, of Fall River; secretary, E. J. Stewart, Manchester, N. H.; treasurer, C. G. Rogers, of Boston. A paper on Insurance, in connection with the association, was read by Mr. C. F. Whitney, of Lowell.

PHILADELPHIA NOTE.

MR. A. W. EBELING, for many years connected with The Otto Gas Engine Works, in this city, has resigned his position as secretary of the above company. He proposes to take a vacation this summer before assuming fresh business burdens.

WESTERN NEW YORK NOTES.

THE NIAGARA FALLS PARK & RIVER RAILWAY is building a connection to the new suspension bridge on the Canadian side at Queenston, Ont.

CONDUITS IN GENEVA.—Geneva is putting down conduits for electrical wires. Nine ducts are laid in cement. The conduit is laid inside the curb so that it may be accessible at any time without tearing up the pavement.

CONDUITS IN NIAGARA FALLS.—Niagara Falls is laying on Second Street its first municipal conduit for electric wires. The conduit is formed of vitrified ducts, laid 10 in a nest. The section now being laid extends from Falls to Main Street.

MR. FRANK G. LOTT has been appointed superintendent of the New York & Youngstown electric road and will look after its interests in connection with his present duties as manager of the Buffalo & Niagara Falls Electric Light & Power Company and superintendent of the Niagara Falls Hydraulic Power & Manufacturing Company.

SOUTHERN NOTES.

THE VIRGINIA ELECTRIC COMPANY'S plant, at Norfolk, Va., has been transferred to a syndicate headed by R. Lancaster Williams, of Richmond, for $700,000. It will be used in connection with the Ocean View railway and Norfolk street railway.

THE WASHINGTON TRACTION & ELECTRIC COMPANY has been chartered, at Richmond, Va., with an authorized capital of $12,200,000. Mr. Samuel B. Lawrence, of New York, is president. The company is authorized to do a general electrical business.

THE STILWELL-BIERCE & SMITH-VAILE COMPANY, Dayton, O., has been awarded the contract for the turbine wheels for the Virginia Electrical Railway & Development Company. The order calls for four pairs of Victor wheels, the contract price being about $20,000.

THE VIRGINIA & TENNESSEE TELEPHONE COMPANY, of Bristol, Va., has been chartered with the following officers: George M. Halstein, president; D. D. Hull, vice-president and treasurer; Beauregard Laughon, general manager. This company proposes to purchase and operate all the telephone systems between Bristol, Bradford and Big Stone Gap.

PITTSBURG NOTES.

MR. P. ACKERMAN, the New York agent of the American Electrical Works of Phillipsdale, R. I., was in this city last week.

MR. W. J. LONGMORE(the purchasing agent of the Westinghouse Electric & Manufacturing Company, has gone to New York, Philadelphia and Boston.

AUTOMOBILES IN PITTSBURG.—A company is being organized in this city to operate automobile carriages between Pittsburg and McKee's Rocks, a distance of six miles. The capitalization of the company is to be $100,000, and operations will be begun with 30 carriages.

ENCLOSED ARCS IN PITTSBURG'S STREETS.—The city of Pittsburg is contemplating the use of enclosed arc lamps for street lighting purposes. Sixty enclosed arcs have been put up on North Highland Avenue and, if the authorities can be induced to allow the expense for making the change, all of the 2300 arc lamps now in use will be substituted by the newer lamp.

MR. JOHN C. HENRY, of Denver, Colo., has been in this city for over a week for the purpose of demonstrating to local street car men the use of "a regenerative controller," an appliance which is claimed to be the best street car brake in existence. The principle of Mr. Henry's invention is the automatic changing of the motors into generators during the process of stopping the car.

OHIO NOTES.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, manufacturer of incandescent lamps and other electrical goods, reports that its lamp department is having the best business in the history of the concern. The company employs 205 hands at the present time.

THE ALLIANCE, SELINA & SALEM ELECTRIC RAILWAY COMPANY, of Selina, has been incorporated, with $100,000 capital stock, to build an electric railway connecting the cities of Alliance, Stark County, and Sebring, in Mahoming County. The incorporators are H. W. Klein, J. C. Witla, H. C. Estep, H. W. Harris, David Fording, C. C. Baker and W. H. Morgan. The incorporators are all residents of Stark County.

NEW ELECTRIC RAILWAY PROPOSED.—An electric railway connecting Toledo and Findlay is practically assured. Messrs. E. C. Deardorf, of Toledo; Theodore Wertz, of Canal Dover, and J. K. Pierson, of Painesville, are the promoters of the enterprise. The right of way has been secured and the railway will pass through Fostoria, Pemberville and other towns. The Toledo terminal has already been purchased. Work will be commenced at once and will be pushed to completion.

CLEVELAND AND INDIANAPOLIS ELECTRIC RAILWAY.—Toledo, Painesville, Cleveland and New Philadelphia capitalists, headed by Mr. J. W. Kinsey, of New Philadelphia, are backing an enterprise to construct an electric railway from Cleveland to Indianapolis. The first link of 16 miles between Findlay and Fostoria will be built as soon as material can be delivered and then the road will be extended 32 miles to Lima. From Fostoria eastward it is the intention to combine and utilize several lines of electric railway already in operation and projected. The plan is to build from Lima southwestward through the Indiana oil fields.

A 143-MILE ELECTRIC RAILWAY.—The Lima, Toledo & Cincinnati Railway Company was incorporated at Columbus a few days ago, to build an electric railway from Toledo to Dayton, a distance of 143 miles. At Dayton connection will be made with an electric line already in operation to Cincinnati and intermediate points. The road has been in contemplation for the past two years. Hon. H. C. Adkins, a member of the state legislature who is the promoter of the enterprise, says that everything has been completed, even to financing the project, and that the contracts will be let for the construction of the road within the next few days. The line is to be equipped with high speed cars. The line will pass through the towns touched by the Cincinnati, Hamilton & Dayton Railway between Dayton and Toledo, except in cases where it is found more advantageous to diverge to larger towns. The company is capitalized for $500,000, which will be increased to $2,500,000 when the work is begun. The enterprise is said to have ample money back of it.

ELECTRIC RAILWAY CONSOLIDATION.—A joint meeting of the stockholders of the Akron, Bedford & Cleveland Electric Railway Company and the Akron Traction & Electric Company, of which railways Mr. H. A. Everett, of Cleveland, is the principal owner, will be held in the near future, when a consolidation of the two roads will be effected under the name of the Northern Ohio Traction Company, with a capital of $3,000,000. The officers of the company will be: H. A. Everett, president; Will Christy, vice-president; Charles F. Moore, secretary; J. R. Nutt, treasurer, and L. E. Beilstein, general superintendent. By those who are on the inside it is said that this combination is the first step toward a consolidation of all the Everett electric railway systems from which is eventually to be evolved a realization of Mr. Everett's dream of a great network of electric railways under one control, connecting Cleveland with every important town in the northern part of Ohio. Will Christy, vice-president of the new company, is president of the Cincinnati & Hamilton Railway Company, also of the Cincinnati & Miami Valley Railway, and it is predicted by some that the Everett system may eventually extend across the state from Cleveland to Cincinnati.

INDIANA NOTE.

INDEPENDENT LONG DISTANCE TELEPHONE SYSTEM.—Arrangements are almost perfected to connect the New Telephone Company, of Indianapolis, with the Independent Company at St. Louis. Mr. H. J. Hanford, representing the St. Louis Company, has agreed to build a line to the Indiana border if the new Indiana long distance company will put up a line from Indianapolis to the Illinois border, and it is announced that this will be done. The new company has now 1500 telephones in service in Indianapolis and expects to be serving all its subscribers by July 1.

CHICAGO NOTES.

MR. J. G. SATTERTHWAIT, formerly with Walker & Kepler of this city, is now connected with the Philadelphia office of the C & C Electric Company at 45 North Seventh Street. Mr. William Meyers is the manager of this office.

MESSRS. SIEGEL, COOPER & CO., Chicago, have placed an order with the Western Electric Company for one 125-kw direct current generator and one 80-light arc dynamo. These machines are to be installed in their store in Chicago.

MR. W. P. SULLIVAN has been appointed representative of the Mackenzie Furnace Company, Chicago, for the sale of its furnace and grate bars, and other goods used in boiler and engineering work. Mr. Sullivan is well and favorably known in the electrical trade.

THE CHICAGO UNION TRACTION COMPANY has filed incorporation papers at Springfield. Its capital stock is $32,000,000, of which $12,000,000 is preferred and $20,000,000 common stock. The company has leased the North Chicago and West Chicago street railways for a long term of years. The stockholders of the North Chicago and West Chicago Street Railway Companies have voted to lease their respective systems to the new company. Mr. Charles T. Yerkes announced his retirement as an active officer of the companies.

STREET RAILWAY COMMISSION FOR CHICAGO.—The Council Finance Committee has decided in favor of Alderman Herrmann's order for a street railway commission to study street railway problems in eastern states and in Europe. It was decided that the street cleaning and garbage problems should be studied at the same time. In connection with the same subject, the committee recommended the passage of the ordinance already introduced, providing for a street railway expert to be employed by the city. The expert will go to Europe with the commission if the council passes the Herrmann resolution.

CHRISTENING A MUNICIPAL ELECTRIC LIGHT PLANT.—Municipal ownership of electric light plants involves the solution of some problems that are not encountered when such enterprises are owned and managed by private companies or individuals. Not the least of these difficulties is the bestowal of an official designation upon such plants. Chicago has met this problem and in its solution has introduced a new idea in electric light practice. Mayor Harrison has decided to name the new plant, which is to be located at Sixty-fourth Street and Wentworth Avenue, the Robert A. Waller Municipal Lighting Station. This honor is conferred upon the late comptroller because he was foremost among the promoters of the scheme for a new plant in the southern part of the city.

WISCONSIN NOTES.

THE MILWAUKEE-CHICAGO ELECTRIC LINE has been refused a franchise to pass through the city of Evanston, Ill.

VOTING FOR A MUNICIPAL PLANT.—A special election will be held July 13 at Waupun, Wis., to vote on the question of issuing $6000 of bonds for a municipal electric light plant.

THE FOX RIVER ELECTRIC RAILWAY & POWER COMPANY, of Green Bay, has elected Mitchell Joannes general manager. Extensive improvements are to be made in the service and the lines in the city and in De Pere.

BIDDING FOR A LIGHTING PLANT.—The city of Columbus, Wis., is receiving bids on machinery supplies and construction work for its proposed electric lighting plant. Figures will be received for both alternating and direct-current systems and they must not exceed $10,000 complete.

THE MILWAUKEE LIGHT, HEAT & TRACTION COMPANY will prosecute its suit against the city of Kenosha to secure the publication of the ordinance granting a franchise to the company through the city of Kenosha. The company has been seeking the right of way for some time, which is necessary to make the connecting link for the Milwaukee-Chicago electric line.

ST. LOUIS NOTES.

TELEPHONES FOR MISSOURI TOWNS.—Lebanon, Mo., is having a system of telephones put in. Philipsburg, Conway and Linn Creek are to be connected and the wires will extend to St. Louis.

ALTON LIGHT PLANT ORDERED SOLD.—A judgment was entered against the Alton Gas & Electric Light Company in the Alton court June 1, in favor of the American Trust & Surety Company, for $69,000. The court ordered the plant to be sold on July 1. There were three cases for the three sets of bondholders, all of the cases being consolidated.

AUTOMOBILES IN ST. LOUIS.—An automobile service will be in operation here by fall. St. Louis capitalists have decided that it can be made a satisfactory investment here, so a company to operate the service will be organized within the next 30 days, to be composed almost exclusively of St. Louisians. Both a passenger and freight service will be inaugurated.

NEW TELEPHONE SERVICE.—The Kinloch Telephone Company has announced that it will soon add a long-distance service to its local exchange. The first line will be to Indianapolis by way of Terre Haute, Ind. The long-distance line will embrace many towns in Illinois, Indiana and other states of the Mississippi Valley. A new company was recently formed, the purpose being to connect all the independent exchanges by a long-distance system.

FRANCHISE TAX.—The State Board of Equalization has adopted a resolution sent by Attorney General Crow, assessing the franchise of the St. Louis & Suburban Railway of this city at $1,793,500, as follows: Twenty-nine sixtenths miles of track and trolley wires, $291,600; 86 motor and passenger cars, $72,240; 13 all other cars, $2080; 2 sweepers, $200; lands, buildings and machinery, $1,766,890; all other property, $1,250,490; total, $1,793,500. It is expected that the St. Louis & Suburban Railway will at once bring this matter before the Supreme Court by asking that tribunal for a writ of certiorari to quash the assessment by the board. The Suburban served notice upon the State Board of Equalization that it would contest the levy and that it would carry the matter through the courts if the board put into effect the franchise tax. It is expected that other roads will do likewise, and that the corporations will refuse to pay the tax until the question has been decided by the Supreme Court of Missouri.

TEXAS AND MEXICO NOTES.

ELECTRIC HEADLIGHTS IN MEXICO.—The passenger engines of the Mexican National Railway Company have recently been equipped with electric headlights.

THE FEDERAL TELEGRAPH COMPANY, of Mexico, has just opened a new telegraph line between Altar and Caborca, State of Sonora, Mexico. This line is very important in the transaction of official business between the two sections which it connects.

A MEXICAN TELEPHONE LINE.—A long distance telephone line has just been established between the City of Mexico and Puebla, Mexico. It was constructed by order of Engineer Augustin M. Chavex, director of Federal telegraphs of Mexico. It will be used mainly for government business.

THE CITIZENS' TELEPHONE COMPANY OF TEXAS was recently organized, with a capital of $100,000. The principal office is at Houston, Texas. The purpose of the company is to build, erect, buy, operate and maintain a system of telephones, telephone lines, telephone plants and telephone exchanges in Houston and other cities, towns and villages of Texas. The incorporators are A. L. Waterbury, E. A. Glass, F. C. Bogart and W. G. Lears, of Houston, and W. Bucklin, of Marble Rock, Iowa.

PACIFIC COAST NOTES.

MR. JOHN I. SABIN was re-elected president of the Sunset Telephone & Telegraph Company, and of the Pacific Telephone & Telegraph Company, San Francisco, at the late election of directors and officers.

DEMAND FOR ELECTRIC POWER.—Owing to the increased demand for electric power at Stockton, the Standard Electric Company, whose plant is located at the Blue Lakes, has decided to duplicate its power line to Stockton. Another pole line will be put up at once, with a capacity of almost double that of the first one. The larger line will be run to San Francisco, via San Jose and the Peninsula, with a branch from Alviso to Oakland. Power will be delivered in Stockton by the middle of June, but the lines to San Francisco and Oakland will not be ready for operation for several months.

THE ELECTRIC AGE OF THE COMSTOCK.—A 30-mile electric transmission from the Truckee River will supply power to operate the mines now being pumped out under the auspices of the Comstock Pumping Association. Work upon a wood-pulp mill plant has been commenced at Floriston, Nev., and the capitalists interested will install an electric power plant also. The Floriston Electric Light & Power Company is to be formed for the purpose of transmitting power to the Comstock for operating hoisting, pumping and ore reduction plants. The site of the generating station is on the Truckee River, about eight mile west of Verdi, where a three-mile water right has been acquired. Some of the leading capitalists of the coast are interested in the enterprise.

THE CITY OF STOCKTON, CAL., was lighted by electricity transmitted from Blue Lakes City for the first time on June 3. The Standard Electric Company, of California, organized by Prince Poniatowski, purchases the power from the Blue Lakes Water Company's water power plant and transmits it 43 miles to Stockton, where it is reduced from 25,000 volts to 2200 volts and then distributed from the switchboards of the Stockton Gas & Electric Company. About 1000-hp is available for transmission to Stockton at present. An additional electric generating station will be established by the Standard Company, where the available head of water will be about 1480 feet. A force of men is already engaged in improving the hydraulic work. The recent extension is but a step in the colossal plans of the Standard people, as contracts have been entered into to furnish the Oakland Gas & Electric Company with all the electric power necessary for lighting the city of Oakland, Cal. The service is to begin in June, 1900. Aluminum wire is in successful use on the main lines. Within two years, it is expected, San Francisco will be reached, and 3000-hp has been contracted by the San Francisco Gas & Electric Company. The street car lines of Oakland, San Francisco and San Jose will be operated by the current from Blue Lakes, if satisfactory terms can be made. Ten thousand horse-power will ultimately be transmitted to San Francisco, the distance being 110 miles.

CANADIAN NOTES.

THE BRITISH PACIFIC CABLE.—Sir Sandford Fleming, of Ottawa, has received a cable from England announcing that the council of the British Empire League had endorsed Canada's position on the Pacific cable question, and had expressed the hope that every effort would be made to overcome any obstacle that might delay co-operation of the mother country in the proposed undertaking.

THE MONTREAL ELECTRIC STREET RAILWAY COMPANY has decided to increase the wages of its employees 5 per cent. This action is entirely voluntary on the part of the company. The conductors and motormen will benefit, as, in addition to having their income increased, they will also have free insurance in some accident insurance company of good standing, to the extent of $1000, and free uniforms. The increase of wages applies to all motormen and conductors who have been regularly in the company's service for two years or more. The company has decided to double-track the Verdun extension out to Queen's Park, and to vestibule all cars, front and rear, for the comfort of motormen and conductors. It has also decided to equip its cars with the best fender obtainable.

A WATER POWER SCHEME.—A gigantic scheme for damming the Ottawa river at Mechanicsville, about two miles from the City of Ottawa, is attracting much attention at the Dominion capital. It is proposed to build a dam across the river, at this point, high enough to do away with the Remoux rapids. By so doing the anchor ice, which has given so much trouble to the Ottawa power houses every winter in recent years, would be avoided, and over 40,000-hp would be available. Of this power, one-half would be on the Ontario side of the river and the other half on the Quebec side. This power will be utilized by constructing a canal parallel to the shore, the power houses being placed on the strip of land between the canal and the river, with the flumes emptying back into the river. These works, when completed, will give Ottawa probably the largest amount of water power of any city on the continent except at Niagara.

ELECTRIC VEHICLES IN CANADIAN CITIES.—It is announced that the syndicate of American capitalists, which is behind the New York Gas and Electric Light, Heat and Power Company, the American Electric Vehicle Company, and the Electric Storage Company, is forming a sub-company in Toronto and other Canadian cities, in which local capitalists will be largely interested in order to introduce horseless vehicle service on the Canadian side, and that as soon as the necessary number of auto-vehicles of the styles most popular and necessary can be manufactured, the service will be actively introduced. It is contemplated not only to cheapen cab and carriage fare in Toronto and every other city where the service is established, but also eventually to establish an automobile delivery wagon and truck service for the benefit of merchants, and further to invade the field of the local and general express companies and establish terminal transfer system and auto-wagons "on call" to compete with the individual express wagon owners and the general express companies in the collection and delivery of baggage, freight and merchandise.

General News.

THE TELEGRAPH AND TELEPHONE.

LOUISVILLE, KY.—The Bengal Telephone Company has been organized in Taylor County.

DECATUR, ILL.—The Citizens' Telephone Company has increased its capital from $3440 to $5660.

UTICA, N. Y.—The Fulton Chain Telephone & Telegraph Company has increased its capital stock from $4000 to $25,000.

PINE BLUFF, ARK.—The Southwestern Telegraph & Telephone Company has purchased a site on which it will erect a new $12,000 exchange building.

SHERIDAN, ILL.—The Sheridan Telephone & Electric Company has been organized here, with a capital stock of $50,000. The directors are J. H., J. D. and L. D. Cox.

MACKENZIE, TENN.—The Carroll County Telephone Company has been granted a franchise in this city. The work of putting in a plant will be commenced at once.

EUREKA, IND.—The Iuse & Ohio Township Telephone Company has been incorporated, with a capital stock of $1150, by Allen J. Payton, John Chewing and W. H. Jones.

SALT LAKE CITY, UTAH.—The Lewiston & Grangeville Telephone line has been purchased by the Inland Telephone Company. The new owners took possession on June 1.

WINONA, MINN.—The Winona Telephone Company will install a new metallic switchboard with 1200 drops in its new exchange in this city. The improvements in the system will cost about $6500.

POTTSVILLE, PA.—The Postal Telegraph-Cable Company is seeking the right of way for a line from Reading to Pottsville. It is stated to be the intention to extend the line to Williamsport and Buffalo.

ATHENS, OHIO.—The Athens Telephone Company has been organized, with a capital stock of $10,000. The incorporators are T. J. Long, G. Crow, L. W. Rose, J. L. Emerson and J. R. Long, all of Athens.

BELLEVILLE, N. J.—The New York & New Jersey Telephone Company is seeking a franchise in this township. In return for the privilege the company will construct a fire alarm system and keep it in condition.

EVELETH, MINN.—The Mesaba Telephone Company has been organized here, with a capital stock of $25,000, by C. W. More, F. C. Talboys, Eveleth; O. D. Kinney, G. W. Buck and W. Harrison, all of Duluth.

WHITESBURG, OHIO.—The Whitesburg & Romo Telephone Company has been incorporated here, with a capital stock of $900, by B. C. Wiesner, T. S. Myers, S. Rodes, W. J. King, S. W. Myers, all of Whitesburg.

TOPSY, MO.—The Harris-Princeton Telephone Company has been organized here, with a capital stock of $600 by F. M. Kolbe, E. Bushlin, Harris; E. Johnson, A. J. Girdner, L. King, Princeton; W. G. Odneal, Harris.

ST. LOUIS, MO.—It is announced that the Kinloch Telephone Company will build a long-distance line through Terre Haute and there connect with the New Telephone Company's system to Indianapolis and other towns in the state.

MARTIN, TENN.—The Weakely County Telephone Company, with a capital stock of $10,000, has been organized in this place by J. H. Nilsue, G. Hall, W. T. Lawler, G. E. Mowden, T. M. Ryan, J. M. Gardner, J. E. Kennedy and T. J. Jeter, all of Martin.

DAYTON, OHIO.—The Central Union Telephone Company has purchased a lot on North Ludlow Street, on which it will erect a three-story building of steel, stone and brick, to be used exclusively as an exchange. The company paid $10,000 for the property.

FORT SCOTT, KAN.—The Union Telephone Company, owning several hundred miles of long-distance lines in southeast Kansas, has been reorganized under the name of the Independent Long-Distance Telephone Company. The capital stock was increased to $50,000.

BRENHAM, TEXAS.—Prominent planters at Independence and Clay Station are arranging to erect a telephone line from Brenham to Clay Station, by way of Independence. The improvement is receiving strong support, and it is believed will be carried to an early completion.

BOSTON, MASS.—The Massachusetts Telegraph & Telephone Company has begun the construction of its Boston system. Conduits are being laid from the post office through Federal Street and up Atlantic Avenue. It is stated that the company has secured contracts for over 3000 subscribers in Boston proper.

TENERIFFE-SENEGAL CABLE.—The Spanish National Telegraph Company (Limited), of London, has recently purchased a complete set of Delany apparatus for the equipment of its Teneriffe-Senegal cable. The system has been on trial for nearly two years, and its adoption is the result of its perfect operation.

FLORA, IND.—The lines of the Flora & Logansport Telephone Company, including the exchange at Flora, have been absorbed by the Bell Company. The Miller Company, a branch of the New Telephone Company, of Indianapolis, has established an exchange here. It is thought that there will be a rate war between the two companies.

CARTHAGE, MO.—The Carthage Electric Telephone Company has sold its exchange in this city and one-half interest in the line to Webb City to J. W. Layne and wife, of Illinois; Henry Coate and wife, and Mrs. Sarah Lee, of Wauseon, Ohio. The price paid for the line was $9000 in cash. The new owners propose to overhaul the lines and exchange and put the property in the best possible condition.

JERSEY CITY, N. J.—The Jersey City Board of Street and Water Commissioners have passed over Mayor Hoos' veto the ordinance granting a franchise to the Hudson Telephone Company to use certain streets for the extension of its lines. The ordinance provides that the company shall pay the city 2 per cent. of its gross receipts, and give all departments of the city government free telephone service. The mayor did not consider the compensation sufficient.

PROVIDENCE, R. I.—The Providence Telephone Company has been incorporated, with a capital stock of $100,000. The incorporators are H. Howard, H. G. Russell, R. Hazard, H. C. Cranston, G. R. Phillips, R. M. Larned, F. W. Carpenter, all of Providence. The company's charter was amended by the Rhode Island legislature on June 1, giving the company the right to dispose of some of its property and lease or let underground conduits or ducts to other companies.

MANCHESTER, VA.—The Chesterfield & Powhatan Telephone Company has applied for a charter at Chesterfield Courthouse. Officers for the first year are: President, W. W. Baker; vice-president, J. B. Fisher; treasurer, B. T. Watkins; secretary, W. P. Fields; directors, A. L. Adamson, R. A. Justis, P. V. Cogbill, M. A. Cogbill, J. Nelson, J. B. Watkins, L. P. Hill and the officers. The object of the company is to furnish telephonic connections with Chesterfield, Powhatan and adjoining counties.

GALLIPOLIS, OHIO.—The Central Union Telephone Company will reduce its rates to old subscribers after July 1 to $1 per month for independent lines and 50 cents per month for party line service. These rates take effect immediately for new subscribers. The former rates were $2 per month for independent lines and $1.50 for party line service. The new Home Company, which was recently organized, has begun the erection of its lines, and it is inferred that this was the cause of the reduction of rates by the old company.

ALBANY, N. Y.—The New York Suburban Telephone Company was incorporated here on June 5, with a capital stock of $10,000, and the privilege of increasing it to $100,000. The lines will connect Yonkers, Mt. Vernon, New Rochelle, White Plains, Tarrytown, Poughkeepsie, Nyack, Portchester, Rye and other adjacent towns. The directors are Albert Deveau, William Caxton, Chas. Auth, of New York City; Harry A. Mott, Rye; James P. Powers, Elizabeth, N. J.; George F. Archer, of Mt. Vernon, and Hiram O. Hance, Plainfield, N. J.

MILWAUKEE, WIS.—A special meeting of the stockholders of the Wisconsin Telephone Company will be held here on June 19, for the purpose of increasing the capital stock of the company from $1,200,000 to $3,000,000. The proceeds of the sale of the stock will be used in extending the long-distance lines throughout the state, the erection of eight or ten exchange buildings and the increase of the number of subscribers in the state by at least 15,000. When this extensive work is completed the Wisconsin Company will have at least 25,000 subscribers and a very complete telephone system.

OMAHA, NEB.—The war of rival telephone companies at Plattsmouth has reached a point where the mayor of the town has threatened to order the poles of the Nebraska Telephone Company cut down. The Independent Telephone Company reduced the rates some months ago to $3 and $2, respectively, for office and residence instruments, and this caused a succession of cuts in rates until 50 cents is now the monthly charge. The Bell Company has about 200 patrons and the local company about 150, the Independent Company appearing to have the support of the mayor and council. The Bell Company was enjoined from resetting its poles, but disregarded the injunction. This caused the threat of the city authorities to cut down the new poles.

ELECTRIC LIGHT AND POWER.

AVOCA, N. Y.—The Avoca trustees have granted to E. L. Bailey, of Dundee, a franchise for an electric light plant.

GALESBURG, ILL.—The Galesburg Gas & Electric Light Company has increased its capital from $200,000 to $350,000.

GRAND RAPIDS, WIS.—The Twin City Electric Company has purchased the poles and wire of the Central Electric Company and will proceed with the erection of a new electric light plant.

NEW YORK, N. Y.—The engineering bureau of the Navy Department at Washington has completed plans for a large electric power plant for the Brooklyn Navy Yard. The plant will cost about $100,000.

ALTON, ILL.—The Alton Gas & Electric Light Company will be sold on July 1 by the master of chancery to satisfy a judgment against that company in favor of the American Trust & Surety Company for $69,000.

LIBERTY MILLS, IND.—Mr. E. S. Rittenhouse, of this place, expects to develop a fine water power located here and install an electric power and lighting plant to furnish power and light to factories and to the town.

PORTSMOUTH, VA.—The Portsmouth Electric & Gas Company has been organized, with a capital stock of $50,000, by W. T. Reed, G. Hatton, J. L. Biliosly, R. E. Cramp, J. T. King, all of Portsmouth, and Charles O. Haines, Norfolk.

ALBANY, N. Y.—The Hudson River Power Transmission Company at Mechanicville has applied for permission to build a transmission line along the Champlain Canal from Mechanicville to Albany for the purpose of supplying electric light in this city.

WHEELING, W. VA.—The Belmont Electric Light and Power Company has been organized here, with a capital stock of $100,000. The incorporators are J. Clements, C. Rosser, Bellaire, Ohio; L. F. Gerrish, Wheeling; J. T. Flynn and T. E. Shelley, Bellaire.

LYONS, N. Y.—The Newark Gas Light & Fuel Company has been organized here to furnish gas, electricity and power. The capital stock is $50,000. The directors are Edward H. Jenkins, Clark L. Ingham, John Otto and George D. Webster, of Buffalo; Mitchell Chadwick, of Newark; Edwin E. Witherby, of Lockport.

RICHMOND, VA.—The E. P. Allis Company, Milwaukee, Wis., has been awarded a contract by the Virginia Electrical Railway & Development Company, of this city, for three 1500-hp vertical steeple engines, to run at a speed

of 110 revolutions per minute. The engines are to be a part of the auxiliary steam plant of the water power company.

LEBANON, PA.—The United Power & Transportation Company, recently organized at Trenton, has secured control of the plant of the Edison Electric Illuminating Company in this city. The Transportation Company also controls the two electric street railways running into this city. It will expend about $100,000 in improving the lighting plant.

JERSEY CITY, N. J.—The United States Electric Company of New Jersey, which recently acquired control of the electric plants in Essex, Hudson, Union and Morris Counties, has filed a mortgage for $20,000,000 with the New York Title Guarantee & Trust Company of Jersey City. The mortgage is given to secure bonds issued to purchase the control of plants secured by the mortgagor.

SOUTH OMAHA, NEB.—The Magic City Electric Light & Power Company has been granted a franchise in South Omaha to furnish light and power. This company is composed of employees of the New Omaha Thomson-Houston Company, of Omaha. Current is to be supplied from the Omaha plant at about 10,000 volts' pressure, the distance from the plant to the point of distribution being between five and six miles.

WILMINGTON, DEL.—The Wilmington City Electric Company, which controls the electric lighting in Wilmington, has passed into the hands of the Wilmington Power & Transportation Company. At a special meeting of the directors of the electric company, Mr. John A. Rigg was elected president; H. C. Moore, vice-president; K. A. Fichthorn, of Reading, secretary and treasurer. Mr. Rigg has been elected president of the Wilmington City Railway Company, succeeding Mr. C. M. Clark, of Philadelphia.

GLENS FALLS, N. Y.—The Glens Falls Gas Light Company and the Glens Falls Electric Light & Power Company have been sold to a syndicate, and the two plants will be owned and operated hereafter by a company which will be known as the Glens Falls Electric & Gas Company. The organization of the new company has not yet been perfected, and until then no changes will be made in the management of the two concerns as they now exist.

SANTA FE, N. M.—The old plant of the Santa Fe Electric Company has been sold for $4198, under a decree of foreclosure for indebtedness of $9000. The property was bought by Charles F. Strutt, of New York, for English bondholders. It is expected that the purchasers with other English capitalists will finish the dam and reservoir north of town at a cost of $400,000. They will then utilize the whole power house and in addition will erect a beet sugar factory at a cost of $300,000.

AVOCA, PA.—The Standard Electric Light, Heat & Power Company has just closed one of the largest contracts ever made in the Wyoming Valley. It will furnish incandescent light to eleven mines and five breakers; also 25 arc lights for the Pennsylvania Coal Company and the Erie & Wyoming Valley Railroad. The company will at once proceed to enlarge its plant at Avoca. The installation will be made by Superintendent Frank Howard, of the Standard Company.

UTICA, N. Y.—The Trenton Falls Electric Light & Power Company, of Utica, N. Y., has been incorporated, with a capital stock of $55,000. The object of the company is to furnish several villages in this vicinity and the cities of Utica and Rome with electricity for all purposes covered by the terms light and power. The directors for the first year are M. Jesse Brayton, Herman L. Scheuch and Horace B. Sweet, all of Utica. These three gentlemen are connected with the Utica Electric Light Company.

THE ELECTRIC RAILWAY.

FOND DU LAC, WIS.—The Fond du Lac Street Railway Company has purchased the local electric light company for $110,000.

COVINGTON, KY.—A number of citizens of this place are projecting an electric railway from Covington to Big Bone, Boone County, a distance of 21 miles.

LOGANSPORT, IND.—The Indianapolis & Logansport Traction Company has become owner of all the railway franchises heretofore owned by other parties in this and Carroll County.

VINCENNES, IND.—The Vincennes Traction Company has been organized here, with a capital stock of $100,000. The directors are B. G. Hudnut, C. A. Gordon and A. G. Adams.

KANSAS CITY, KAN.—The power house and car barns for the Kansas City & Leavenworth electric railway are to be erected at Connors. A tract of land, 43 acres in extent, has been purchased.

POTTSVILLE, PA.—The Pottsville Union Traction Company, with a capital stock of $100,000, has been organized here by R. Steen Martin, John M. Emery, Norman A. Taylor, P. Barre and John G. MacPherson, all of Philadelphia.

BROOKLYN, N. Y.—The work of equipping the Fifth Avenue branch of the Brooklyn Elevated Railway with electric power is progressing favorably. It is expected to have the system in operation as far as Thirty-sixth Street very shortly.

MT. VERNON, N. Y.—The Union Railway Company has purchased three acres of land in East Chester and is preparing to erect a large power plant and car barn to be used for the operation of its lines in Mt. Vernon, New Rochelle and Yonkers.

ROCHESTER, N. Y.—Attorney H. C. Mitchell, of this city, is one of the projectors of a proposed new electric railway in Genesee and Orleans Counties. The estimated cost of the construction of the roadbed is $400,000 and that of the rolling stock $100,000.

HUDSON, N. Y.—The Catskill Electric Railway Company has given to the Hamilton Trust Company, of New York, a mortgage on its property for $400,000. It is thought that the company will in the near future build an electric railway between Catskill and Cairo.

KALAMAZOO, MICH.—The Michigan Traction Company has let the contract for the construction of the electric railway from Kalamazoo to Battle Creek to the American Engineering Company, of Philadelphia. The work of grading will commence at once and the road will be finished by October.

BRISTOL, R. I.—The Barrington, Warren & Bristol Street Railway Company has been incorporated, with a capital stock of $500,000. The names of the incorporators are Orrin S. Anthony, Drownville, and Charles H. Handy, Charles B. Rockwell, A. T. Potter, Benjamin F. Manier, Jr., of Providence.

HANNIBAL, MO.—The Hannibal Traction Company has been organized here, with a capital stock of $75,000, for the purpose of extending and operating the Hannibal street railway. The incorporators are R. H. Stillwell, E. D. Brewington and George D. Clayton, of Hannibal, and Haynes Brothers, of New York City.

KENOSHA, WIS.—The long fight between the city and the Milwaukee Light, Heat & Traction Company has come to an end in favor of this city. The railway company will present an entirely new proposition to the city and will ask for a franchise to build a road through some of the side streets, on which it may carry both passengers and freight.

JUNCTION CITY, KAN.—Representatives of Philadelphia capitalists are obtaining options on the Fogarty flouring and electric light plants and also on a large tract of land between the city and Fort Riley, for the purpose of building a street railway between the two points. A franchise has been asked for. The company will enlarge the electric light plant, run the railway to Fort Riley and also light that post.

ATLANTA, GA.—Application has been made for a charter to build a line from Gainesville, Ga., through various counties to some connecting point with the Southern Railway in Tennessee. The road is being built for the purpose of reaching the gold fields of North Georgia and the marble and granite quarries in that section of the State. A water power plant will be built in the mountains, at which point electric current will be generated for the operation of the new road.

BOSTON, MASS.—Another important consolidation of Massachusetts street railway properties is forming. The movement started with the Hanover Street Railway Company and, in addition to that corporation, includes the Hingham Street Railway Company, the Rockland & Abingdon Street Railway Company, the Bridgewater, Whitman & Rockland Street Railway Company and the Braintree & Weymouth Street Railway Company. All of these lines are in Plymouth County, and they desire to consolidate under the name of the Hanover Street Railway Company.

LEGAL.

THE STRONG CURRENT PROTECTOR CASE.—A patent decision was rendered at Washington, D. C., on June 1 in the Strong current protector case on an appeal of the Western Electric Company. This suit, we are informed, was brought by Mr. Frank B. Cook, of the Sterling Electric Company, over two years ago, and this decision is the third one which has been rendered in his favor. The protectors covered by these patents are largely used by Bell and independent telephone companies, and are used for the protection of telephone exchanges as well as subscribers' stations.

PERSONAL.

MR. MAX LUHN has resigned his position as manager of the Helios Electric Company, of Cologne-Ehrenfeldt, to join the German Mutoscope & Biograph Company, of which he is one of the principal shareholders.

MR. P. F. SULLIVAN, general manager of the Lowell & Suburban Street Railway Company, has been appointed general manager of the Massachusetts Electric Companies, which has recently been consolidating a number of the street railways in the state. Mr. Sullivan is well known in the field and is manager of the Massachusetts Street Railway Association.

MR. W. H. HARDING, of the Bridgeton, N. J., Electric Company, has been made superintendent of the National Electric Company, which is buying up various plants and operating them. Mr. Harding served the General Electric and Fort Wayne companies for nine years, and has an unsurpassed experience in the electric lighting field, as manager, etc. His headquarters will be in Philadelphia.

Trade and Industrial Notes.

THE ECONOMIC ELECTRIC COMPANY has been organized at Wilkesbarre, Pa., with a capital stock of $75,000.

THE ELECTRIC CARRIAGE & BATTERY COMPANY, of Cleveland, Ohio, and Philadelphia, Pa., has been chartered at Dover, Del., with a capital stock of $1,000,000.

THE CLONBROCK STEAM BOILER COMPANY, Brooklyn, N. Y., announces that Mr. Frank A. Mason is no longer secretary or treasurer, or in any manner whatever connected with that company.

THE POWELL PLANER COMPANY, Worcester, Mass., has changed its name and adopted the style, Woodward & Powell Planer Company. The corporation is under the same management to-day that existed when it was first incorporated, in 1887.

THE ACME ELECTRIC COMPANY, Baltimore, Md., has been organized for the purpose of manufacturing electrical novelties. The capital stock is $25,000, and the incorporators are J. E. Jacobs, J. Hartman, W. E. Schlaegel, B. Talby and G. E. Chase.

THE O. C. WHITE COMPANY, of Worcester, Mass., is sending out to the trade mail cards containing illustrations of its special line of adjustable incandescent lamp fixtures for office, library and house. Six styles are so illustrated. Lamps can be adjusted to any angle by the use of these fixtures.

EXTENSION OF PLANT.—The Wheeler & Wilson Manufacturing Com-

pany are making extensive improvements in their plant, and have placed the contract with the Berlin Iron Bridge Company of East Berlin, Conn., for a new foundry building, and also for a one-story building covering a portion of their present yard.

CROCKER-WHEELER COMPANY, in its literature issued during the Electrical Exhibition, made the striking statement that it is the "oldest maker of all sizes of machine to remain in the field unchanged in its organization." The pamphlet containing this statement has a cover on which is shown in colored ink a field ring of one of the company's large generators.

THE ELECTRIC APPLIANCE COMPANY has decided to bring out its well known "Acme" tape hereafter under the name of "Eaco." This has become necessary as the reputation gained by its genuine Acme tape has caused the name to be adopted by other manufacturers. Poor tape is about the least desirable article known to the electrical profession.

THE ZECO ENCLOSED ARC LAMPS, as supplied by the Central Electric Company, Chicago, are finding increased sales by reason of satisfactory returns to electrical stations. Simplicity carried to a reasonable limit, together with the best mechanical construction and a proper proportioning of parts, makes the Zeco arc reliable in burning and of lasting service.

ADVERTISING has become such an important adjunct to successful business concerns that more attention is now being paid to the character of the "copy." The Trade Paper Advertising Agency, 150 Nassau Street, New York City, is sending out a little booklet entitled "Advertising Designs," which shows some handsome specimens of good advertising. It is free to all advertisers using trade journals.

MESSRS. ROTH BROS., Chicago, report a large demand for their new type of multipolar motor. Notwithstanding their increased facilities for handling business, they are still several weeks behind in filling their orders. This new machine is claimed to be one of the handsomest and best running machines on the market. Mr. Roth is particularly desirous that all prospective purchasers of motors should get his prices.

MESSRS. WM. BARAGWANATH & SON, 48-52 West Division Street, Chicago, give, in a recent catalogue, comprehensive descriptions and excellent illustrations of their steam jacket feed water heaters of the standard, inverted and horizontal types; plain tubular heater; horizontal open heater, with pans; upright and horizontal open heaters and receiving tanks; live steam purifier, and the Baragwanath siphon condenser.

THE HICKS GAS ENGINE COMPANY has moved its business from Detroit, Mich., to Buffalo, N. Y., where it has secured ample facilities for the manufacture of its engines. The company is now at work on a number of large engine orders. The Detroit plant was inadequate for the proper handling of the business, and the company was compelled to cancel many orders for engines, owing to its inability to get them out on time.

THE CHARLES MUNSON BELTING COMPANY, recently organized in Chicago, is now in a position to supply the trade with its product. The Munson belt has for the past 33 years held a high reputation among American manufacturers, which reputation the new company will maintain. The new company is fully equipped to furnish the best belting of all grades of pure oak tannage on short notice and is prepared to meet every demand made upon it.

ELECTRICALLY DRIVEN FANS.—As the temperature increases, so does the desire to keep cool. To this end a positive circulation and renewal of air is necessary, and may be secured in the simplest manner by an electrically driven fan. A most carefully designed apparatus of this type is that illustrated and described by the B. F. Sturtevant Company in its bulletin M. The fan is designed to move air in large volumes, not merely to agitate it.

THE VALENTINE-CLARK COMPANY.—Mr. E. Clark, general manager of the Valentine-Clark Company, Chicago, reports that his company is doing an unusually large business in poles this season, and that its yards at Pinconning, Mich.; Green Bay and New London, Wis., are in first class condition and well stocked. The poles are well assorted and in good shipping condition. The company is now in position to fill orders with a reasonable degree of promptness.

THE WESTERN ELECTRIC COMPANY, Chicago, has distributed catalogues on the Petite arc lamp to the trade and desires that those who are interested and who have not received a copy write for same. It is also mailing to the trade a neat circular descriptive of the Matchless electric lighter. These lighters are made of the finest white china and can be operated with batteries, or connected to electric light mains, and have the indorsement of the Board of Fire Underwriters.

ELECTRIC LIGHTING BELTS.—Very excellent proof of the value of the belts manufactured by the Shultz Belting Company, of St. Louis, is shown by the fact that the Trinidad Electric Light & Power Company has just ordered six electric belts, each 51 feet and 6 inches long, 3 ply. The company first ordered belts of the Shultz Company seven years ago and the value of those belts was the cause of the present order for an extension of its plant, which has recently been made.

NEW ENGINE LATHE.—A new 14-inch engine lathe has been placed upon the market by W. C. Young Manufacturing Company, of Worcester, Mass. It is a very substantial and well built tool, with many points of excellence. The compound rest is of entirely new design, is fully graduated, has a quick adjustment and a positive grip. The lateral and cross feeds cannot be engaged at the same time. It has a locking device for holding the carriage when the cross feed is in use. The gears furnished give a wide range of threads, including 11½ pipe thread.

THE FORT WAYNE ELECTRIC WORKS.—The electrical business at Fort Wayne, Ind., during the past ten years has changed its name two or three times. The last change has resulted in some confusion. Many customers of the old company do not seem to have noted the last change in name, and much of the mail intended for the new concern goes to other parties, and is consequently delayed in reaching its proper destination. The Fort Wayne Electric Works desire to call the attention of the trade to the recent change of name. The title of the company is the Fort Wayne Electric Works, Incorporated.

MESSRS. EDWARDS & CO., 144th Street and Fourth Avenue, New York City, recently brought out an illustrated catalogue of its electrical specialties. It differs from most electrical supply catalogues in that it contains illustrations of many new devices and apparatus. Among the special goods shown are hotel annunciator outfits complete, burglar alarms, self-winding clock movements, electric programme clocks, lock gravity drops, bells, gongs, door and window springs, door openers, push buttons, etc., in a large variety. Gas igniters in many types are also illustrated, besides a complete line of switches of various kinds.

PRIVATE GAS ENGINE ELECTRIC PLANTS.—Among notable installations of private electric plants driven by Westinghouse gas engines are those at the residences of Mr. George Gould, Lakewood, N. J.; Mr. Louis Marx, Alexandria, N. Y.; Mr. W. Luttgen, Linden, N. J.; Mr. J. Le Roy Dresser, Oyster Bay, N. Y.; Miss F. J. Clark, Pomfret, Conn.; Mr. A. O. Apgar, Ridgfield, Conn.; Mr. F. C. Beach, Stratford, Conn.; Mr. M. S. Gottfried, Elkhart Lake, Wis.; Mr. F. W. Mathessen, Deer Park, Ill.; Kirkwood Inn, Scarborough Beach, Me. The Florida East Coast Hotel system is also installing Westinghouse gas engine plants in a number of its hotels.

THE HARVARD ELECTRIC COMPANY, 224-226 South Clinton Street, Chicago, reports that it is receiving many orders for Standard fusible cut-outs and lightning arresters. The management takes an optimistic view of the business situation. Mr. Frederic Greer, general manager of the company, reports the sales for this class of goods constantly increasing. It is stated that these instruments are used not only in every independent telephone exchange and by every telegraph company in the United States, but in many foreign lands as well. It is evident from their extensive use and popularity that these cut-outs and lightning arresters are giving satisfaction.

THE AMERICAN TRADING COMPANY has been started in Bangkok, Siam, with a capital stock of $100,000. The shareholders are mostly Americans resident in Siam. The company is organized for the purpose of shipping to and marketing in the United States Siamese products and for selling in Siam American manufactured goods. The company will handle electrical goods. Mr. L. E. Bennett has been in New York recently for the purpose of working up agencies and connections for the new company. His headquarters were at the Hotel Marlborough. The American Trading Company desires to secure catalogues and prices, discounts, etc. Mr. Bartine Farrington is the manager of the company.

THE PAILLARD NON-MAGNETIC WATCHES, made by Mr. A. Becken, corner State and Washington Streets, Chicago, Ill., are recommended for the use of those connected with the electrical industries, electric lighting and electric railways particularly. Heavy electric currents are injurious to ordinary watches, but in the timepieces above referred to these influences are counteracted by the use of a palladium hair spring and a compensation balance. These watches have been on the market for several years and have been subjected to the test of time and actual use under severe conditions. The movement is said to be of high grade and an accurate time-keeper, and the non-magnetic feature makes this a particularly desirable timepiece for electrical men.

THE S. E. I. COMPANY, whose factory and main offices are at Syracuse, N. Y., reports that it has practically recovered from its loss by fire on the night of March 14 last, which destroyed, besides a large portion of its main building, its entire stock of instruments, etc. It also lost a heavy stock of wire which had been received about a week prior to the fire. The company was crowded with orders and was badly hampered in making shipments for several weeks, but now having doubled the number of its employees and bettered its facilities has replaced its stock to a large extent and can make shipments as a general rule the day the orders are received. The S. E. I. instruments are extensively known and are meeting with popularity. The company will be pleased to send catalogues and prices upon request.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg, Pa., has issued three little catalogues on three timely subjects, viz.: Alternating-current fan motors for 1899; direct-current fan motors for 1899, and Wurts non-arcing lightning arresters. The 1899 alternating-current fan motor is of the induction type, the oil chambers requiring but one filling for the season. The four-blade fan has a diameter of 13 inches. The direct-current fan motor is entirely inclosed and protected. The cylindrical shell or housing is made of lacquered brass. It is intended for 110-volt circuits, but it may be operated on circuits having any voltage between 100 and 125. The Wurts lightning arrester is well known for its simplicity, reliability of action and effectiveness of operation. The arresters are made for all classes of service. The three pamphlets contain detail illustrations and brief descriptions of the apparatus and parts. They are designed to give the greatest amount of information in minimum space.

THE UNITED CORRESPONDENCE SCHOOLS, of 156 Fifth Avenue, New York, whose well established methods of teaching by correspondence have become so successful and well known, have recently secured control of the Institute for Home Study of Engineering of Cleveland. All contracts with the Cleveland students will be carried out with additional advantages. The system of instructions employed by these schools has been gradually developed and improved under the able direction of Mr. F. W. Ewald, whose extended experience in teaching by correspondence has enabled him to perfect courses of study in the engineering branches which are complete, thorough and in accordance with up-to-date practice. The system of instruction is such that it is possible to give personal instruction to each student. The student can also work as many hours or as few as he desires and can advance as rapidly as he is able without being held back by others less diligent than himself. On the other hand, if he is unable to devote much time to study he can go along slowly without feeling obliged to hurry to keep up with a class. Competent and practical instructors are employed to prepare instruction and question papers carefully graded, accurate, up-to-date and well illustrated. The remarkable success of the United Correspondence Schools is due to the efficiency and practical value of their courses, and the large number of students daily enrolling in the various courses has made it necessary to enlarge the facilities of the home office and increase the staff of expert instructors.

Record of Electrical Patents.

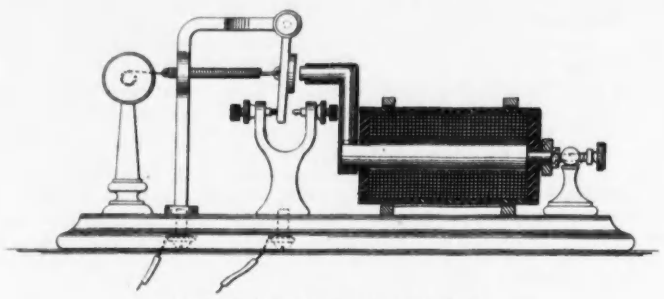
UNITED STATES PATENTS, ISSUED JUNE 6, 1899.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

626,318. FIRE ALARM INSTRUMENT; R. G. Callum, Washington, D. C. App. filed Feb. 20, 1899. The object sought is a transmitting instrument which will show beyond doubt whether an alarm has or has not been transmitted therefrom. This is accomplished by a winding mechanism so constructed and organized that re-winding and re-setting are necessary after each operation, the re-winding and re-setting mechanisms being rendered inaccessible to unauthorized persons.

626,352. APPARATUS FOR HOLDING CARBONS FOR ELECTRIC WELDING; G. W. Betunzelmann, London, Eng. App. filed Jan. 6, 1899. In order to adjust the carbon rod electrodes at a proper angle to each other they are mounted in sliding holders actuated by screw rods, the holders being jointed.

623,364. AUTOMATIC FIRE ALARM SYSTEM; R. G. Callum and J. W. Fritch, Washington, D. C. App. filed Feb. 23, 1899. By means of this



626,606.—Telegraph Receiver or Relay.

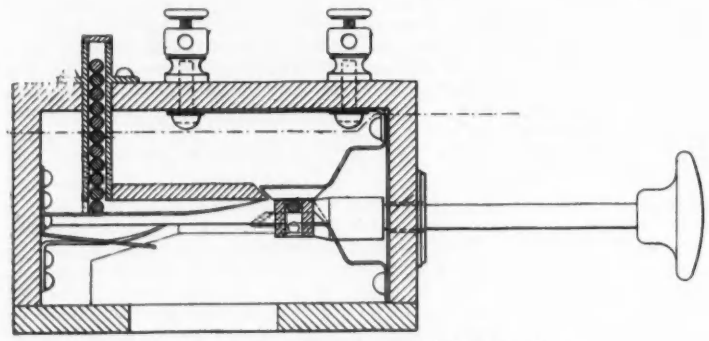
system a warning signal is transmitted to a central station when abnormal heat exists, and a fire alarm follows in case of an outbreak of fire. The warning signal is operated by a thermostat which trips a clock mechanism, and the same thermostat controls the sending of the fire alarm in case the temperature continues to a higher degree.

626,371. DEVICE FOR REMOVING AND REPLACING FUSES; C. E. Duenkel, Jersey City, N. J. App. filed Jan. 26, 1899. The device embodies a magazine for fuses, a shiftable fuse carrier designed to remove the burned out fuse from the terminals, to receive a new fuse from the magazine and carry it to the proper position between the terminals to again complete the circuit.

626,377. ELECTRIC RAIL BOND; S. H. Harrington, New York, N. Y. App. filed June 16, 1898. The end of the bond is fitted with a conical thimble which is inserted into a conical hole in the rail; the metal of the rail is then set into the thimble by a suitable tool.

626,378. ELECTRIC RAIL BOND; S. H. Harrington, New York, N. Y. App. filed June 16, 1898. Constructed like the preceding except that each thimble is provided with a loop extending out from its smaller end through the opposite side of the rail to that in which the thimble is inserted. A wedge is then driven through this loop to hold it in place.

626,382. AUXILIARY ELECTRIC ALARM FOR TELEPHONE CALL BELLS; M. M. Humphrey, Siloam Springs, Co. App. filed May 27, 1898. When the call bell of the telephone rings a lever is moved to close an



626,371.—Device for Removing and Replacing Fuses.

auxiliary circuit extending to any desired point distant from the instrument, thus sounding an alarm at two or more places.

626,460. FILAMENT FOR INCANDESCENT LAMPS AND PROCESS OF MANUFACTURING SAME; Thomas A. Edison, of Llewellyn Park, N. J. App. filed March 31, 1898. (See Current News and Notes.)

626,462. TELEPHONE SYSTEM; W. D. Gharky, Philadelphia, Pa. App. filed Dec. 24, 1898. A multiple station telephone circuit composed of two conductors adapted to be used in common by all the stations for talking purposes, a generator of signaling current and a ringer, at each station, connected on one side to both conductors through bridged impedance, and on the other side to ground.

626,463. TELEPHONE SYSTEM; W. D. Gharky, Philadelphia, Pa. App. filed Dec. 24, 1898. A metallic circuit extending to a number of substations and common to all of them, coils of high impedance bridged across the metallic circuit at the various stations, branches from the middle points of said coils to earth or a return wire, signal receiving instruments included in said branches, signal-transmitting instruments adapted to be connected across the metallic circuit at the various substations, and central office apparatus comprising suitable receiving and transmitting apparatus to co-operate with the apparatus at the substations, all arranged for the avoidance of evil effects of atmospheric disturbances.

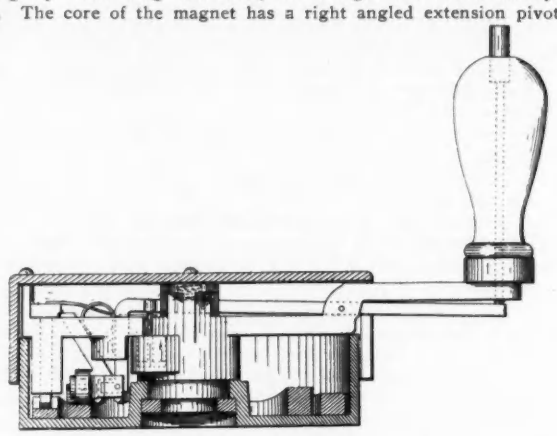
626,494. ELECTRICAL SIGNALING; S. De Jager, Paterson, N. J. App. filed May 26, 1898. This system, which is well adapted for transmitting type-written messages, consists of two sets of devices adapted to co-operate, means for sending electrical impulses of both polarities, and electrically controlled means distinct from each other and actuated by said impulses for operating the respective devices, said means being adapted to effect a co-action of their respective devices when one is actuated by an impulse opposite in polarity to and succeeding the last actuating impulse of the other.

626,496. ELECTRO MOTOR OR DYNAMO ELECTRIC MACHINE; Robert Lundell, New York, N. Y. App. filed Jan. 18, 1899. (See Current News and Notes.)

626,588. WEATHERPROOF SOCKET FOR INCANDESCENT LAMP; W. C. Bryant, Bridgeport, Conn. App. filed Jan. 3, 1899. An insulating body closed at its inner end and having polygonal pockets for the reception of nuts, a metal cup base and screws passing through the latter and the end of the insulating body into said nuts, terminal contacts within the said body, and insulating material poured in, to afterwards harden and hold the contacts in place.

626,592. INSULATOR; J. A. Carpenter & E. F. Tonn, Oxville, Ill. App. filed Nov. 15, 1898. The insulator is designed to obviate the use of tie-wires. It is made in two parts screwed together, one of the parts having lugs spaced apart and having their adjacent faces curved to permit the wire to assume any angular position.

626,606. TELEGRAPH RECEIVER OR RELAY; J. Gallegos, San Jose, De Guatemala. App. filed Dec. 24, 1898. The object is to provide a relay having a powerful magnetic effect, the strength of which is readily adjustable. The core of the magnet has a right angled extension pivoted to it



626,643.—Controller Operating Mechanism.

at one end, and the armature is pivoted on an axis perpendicular to that of the extended pole piece. By moving these parts upon their pivots the distances between the pole pieces and their distance from the armature altered.

626,624. CIRCUIT AND APPARATUS FOR BRIDGING TELEPHONES; C. T. Mason, Sumpter, S. C. App. filed Feb. 4, 1899. A multiple station telephone circuit having at each station a normally closed bridge of the main line, including both bell ringing magnets of low resistance and the armature coils of the generator, said bell magnets being permanently in series with the generator and adapted to be shunted in signaling.

626,627. BICYCLE LAMP; E. D. Middlecow, San Francisco, Cal. App. filed May 21, 1898. The invention comprises a suitable box for the batteries, a lamp fixture thereon, a switch for the circuit of the lamp and batteries and an automatic switch for breaking said circuit when the device is placed upon a table or other fiat surface.

626,629. TELEPHONE; G. J. Payne & A. K. Keller, Philadelphia, Pa. App. filed April 13, 1897. The invention has to do with the construction of the switches, and consists of a system of rotative switches moving with the telephone, the latter also having a rotative movement from a point of rest to a point of use, so that by simply turning the telephone instrument upon a pivot it will close and open the various circuits.

626,643. CONTROLLER OPERATING MECHANISM; W. G. Waganhals, Hartwell, O. App. filed March 29, 1899. To prevent the motorman from moving the lever of the controller too rapidly in throwing the current on, stop devices are provided which retard the handle at each point.

626,655. ALLOY OF IRON AND NICKEL AND ARTICLES MADE THEREFROM; C. E. Guillaume, of Sevres, and L. C. Dumas, of Paris, France. App. filed Nov. 16, 1897. (See Current News and Notes.)

Connecticut Telephones & Apparatus can not be Excelled.

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Connecticut Telephone & Electric Co.
Meriden, Conn.

The ORATOR

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A trial will convince anyone of their superiority on either short or long distance work.

Any one can make an instrument that will work well at first, but to produce one that will CONTINUE to meet every proper demand is quite another problem.

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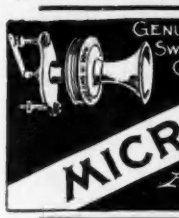

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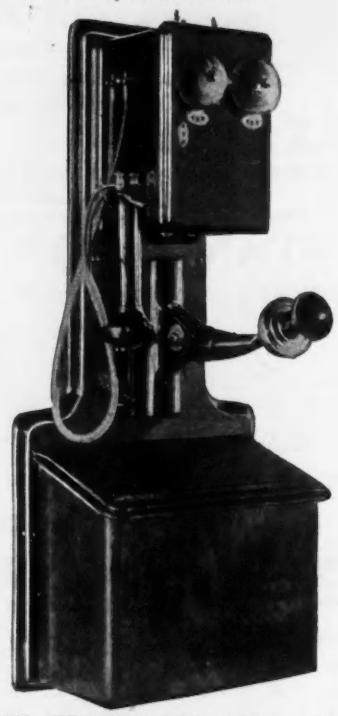

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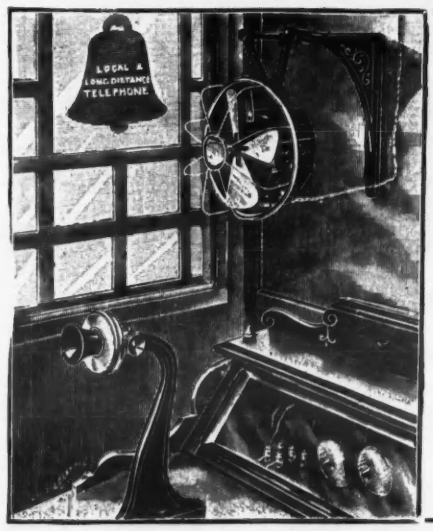

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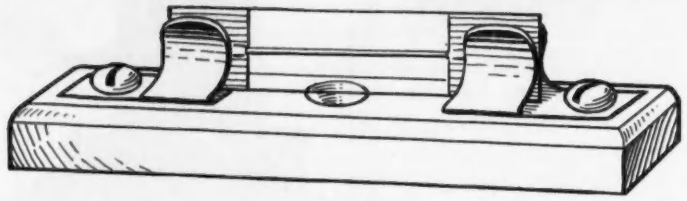

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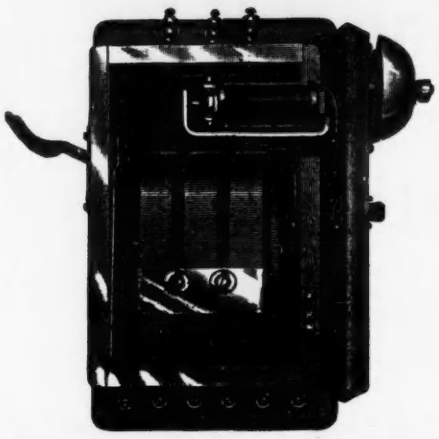

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